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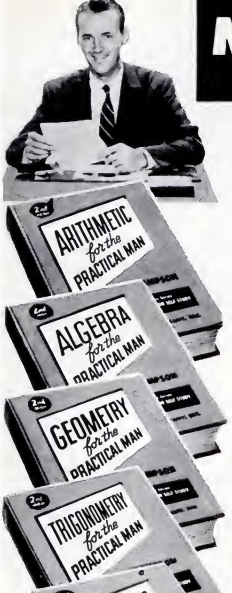

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Popular Science Monthly

September, 1957
Cover photograph by W. W. Morris

First time over the road, it travels piggyback atop this "haulaway"

Can new U.S. weapons protect our coasts from A-bomb-loaded subs? Here are the bone-chilling facts

AUTOMOBILE NEWS

All About the Luxury-Loaded Edsel · 98
Your New Car's First Trip · 128
Free-Pistons: "Engine of Tomorrow" · 138
How to Take Care of an Edsel · 242
Buying Good Retreads · 252

WORLD OF SCIENCE AND INDUSTRY

How Disaster Strikes · 104
Riding the Turnpike Express · 109
"Moonwatchers" Get Set for Satellite · 134
Are We Safe Against Russian Subs? · 161

SPECIAL FEATURES

Your Child Can Earn and Learn · 114
Million-Dollar Drive-In · 118
Toughest Rescue in Mining History · 124
Gus Referees a Bull Fight · 234
Why Buy a Tape Recorder? · 262

THE NEWS IN PICTURES

Missile Gets a Supersonic Boost · 142
Air Hammer Wears a Muffler · 148
Architect's House Uses No Wood · 151
Periscope Watches Nuclear Engine · 152

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ANNUAL HOME-IMPROVEMENT SECTION

How to Buy Loans, Labor, Lumber · 168
6 Ways to Add Living Space · 170
You Can Live in the Basement Now · 172
Expand an Attic by Raising the Roof · 178
Move into Your Garage? · 181
Facts About Building an Addition · 198
6 Locations for That Extra Bath · 198
How to Move a Porch Indoors · 202
Dividers Lick Your Space Problem · 206
Home Tips from House Trailers · 209
4 Space-Making Ideas for Your Home · 212
Building Removable Steps · 214

Roof to cellar: PS tells how to get more living space out of your home

FOR HOME AND SHOP

Folding Rule Is 7 Bonus Tools · 218
PS Fix-It File: Plumbing Drains · 228
Short Cuts and Tips · 277

WHAT'S NEW IN . . .

Keeping the Home Shipshape · 10
Ideas from the Inventors · 158
Handyman Products · 224
Tools for Your Shop · 232
Hints from the Model Garage · 240
Car Accessories · 260

EVERY MONTH . . .

PS Readers Talk Back · 4
Prize Projects by PS Readers · 12
I'd Like to See Them Make · 14
You Ought to Know · 17
Wordless Workshop · 222
PS Shop Notebook · 273

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PS Readers

TALK BACK

In Defense of "Deadliest" Bomber

In reference to Mr. Heason's letter of complaint [June] about glamorizing bombers, I should like to point to a few things he has left out. As concerns the B-52 being a "deadliest bomber," it must also be remembered that it is our best insurance policy for peace. It also has glamor as one of the greatest engineering masterpieces of all times.

I believe Mr. Heason sleeps sounder at night knowing that there are B-52s stationed in England ready to protect him.

Peter D. Veillette,
West Hartford, Conn.

He Likes Picture News

I'd like to compliment you on the improvements in Popular Science, such as Picture News. It's better than having to scramble through the whole magazine searching for one thing or another.

Michael Smith, LaGrange, Ill.

No, Sir, You're Not Crazy

Mr. Phil McCafferty of Cedar Rapids, Iowa, says he has a pile 6′, 5″ high of Popular Science magazines which date back to Nov., 1930. I have him beat by about 13 years. My pile dates back to

July, 1917. My wife says I'm crazy for saving anything that long.

Francis F. Rosen, Faribault, Minn.

DKW Outperforms the SAAB

I have just finished your article, "What You Get in the Foreign Economy Cars," [June] and though I thought it a good article, I feel that a more appropriate two-cycle-engine car to test than the SAAB would be the German DKW . . . It has a top speed closer to 85 m. p. h. than the 75 your specification list says. It is a full five-passenger and, in the sedan, six-passenger. It is very much less austere than the SAAB. It is unexcelled in handling and has excellent performance (0-60 about 20 seconds).

Michael J. Stong, Falls Church, Va.

Foreign-Car Figures

Reading PS with the usual close attention, I seem to find two contradictions in

the tabular data (on the little foreign cars), pages 64 and 65 of the June issue. The very nice Borgward Isabella engine is given a displacement of 14.9 cubic inches. This seems improbable, especially for a 60 hp. rating. The Citroen 2CV is credited with the ability to accelerate from zero to 50 m. p. h. in 13½ seconds. My guess is that the figure should be 23½.

Robert Kruse, Madison, Conn.

Right as rain on both counts. The Borgward displaces about 91 cubic inches. The Citroen's acceleration should have read 23 seconds.

Puzzled Puzzlers

In your article, "Success Without a College Degree" [June], I disagree with the answer to question No. 1 of your sample mechanical-aptitude test. However, the drawings are not accurate enough to be sure. It appears that E makes an octagon instead of B.

Max A. Chapman, Dearborn, Mich.

. . . I discovered a mistake: Question

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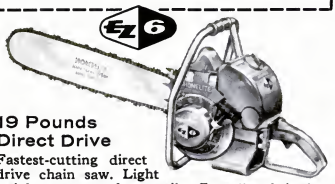

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No. 1 on your mechanical talent test has two answers, B and E.

JEROME BLOTCKY, Des Moines, Iowa

. . . Any mechanic can plainly see the answer is E, not B.

M. M. MOORE, Moonachie, N. J.

. . . It looks to me as if E is just as good a fit as B to make up the figure.

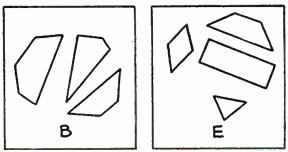
JOE MANN, Roslyn, Pa.

. . . No doubt many other readers were as surprised as I to learn that the unequal-sided pieces in B of the first examination question on your aptitude test would fit together to make the octagon. E is the obvious correct answer—cut out the pieces and try it.

That someone erred is perhaps not important, but it does seem that in extending the do-it-yourself craze to self-tests on everything from sex to psychology, we are often prone to take the word of self-styled experts in a series of "yes or no" and "true or false" tests which are perhaps easier to grade and classify but which will do nothing towards real education.

Thanks for an interesting series on education and jobs.

LOUIS EISEN, Phoenix, Arizona.



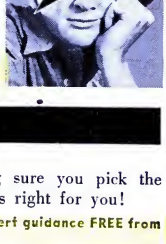
Our drawings were reduced from the size used in the actual tests, and the outlines softened by the color process, so that it is practically impossible for anyone to decide on the right answer for No. 1. But (cross our heart) ONLY the parts in B will form that octagon.

TV Is a Hog on the VHF Band

IN STATING that UHF channels are being given to VHF television stations as a means of equalizing the competition ["You Ought to Know," June], you bypass a major aim of current proposals to eliminate VHF television. There is a severe shortage of channels now, and this will worsen as more radio communication is needed. VHF television now occupies

Can you profit by their mistakes?

"Not getting enough education"



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WILLIAM D. HIBBARD JR.,
Silver Spring, Md.

Wall-Covering Short Cut Sought

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RICHARD L. ZERNES, Newport News, Va.

If a smooth finish is not necessary, you could use a heavy textured paint. Rolled or troweled on, it gives a textured or stucco appearance. We have also heard of builders who use joint cement, but here again the finish is not smooth.

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I'M VERY glad to see your new addition, the Popular Science Reference Library. I know that everyone who receives these splendid booklets will want to keep them for future use where time and money are factors. Thank you for starting this series.

FRED E. SAGER, Bethel, Kansas

The next booklet, on home TV repairs, will appear in the October issue.

Swing-Sway License Plate Illegal

AN ARTICLE and picture [from a California contributor, June, page 200] shows how to mount a license plate so it will "swing free when the trailer rides through tall weeds or roadside gullies." The traffic code here in California, Sec. 158, part B, states: "Every license plate shall at all times be securely fastened to the vehicle for which it is issued so as to prevent the plate from swinging . . ."

J. C. BRANSTETTER, San Francisco

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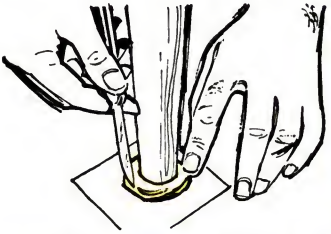
Keeping the Home Shipshape

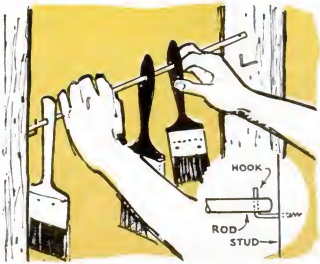


TO LEVEL WOBBLY FURNITURE, put a gob of wood putty on waxed paper, stand the short leg on it and press until even with the others. Trim off the excess putty and sand smooth.

MEASURING SPOONS REACH DEEP if you lengthen them with tubing. Partly flatten 3/8" aluminum tubing, cut the spoon handle to fit and clamp the tube tightly around it in a vise.

CONVERT A BUNK BED—or build a new one without the lower berth—to save space in a small one-child room. Fit the lower part with doors and shelves for storage closets.

PAINTING RADIATORS THIS FALL? For a faster, easier job, try one of the aerosol spray-on paints. Slip sheets of newspaper down behind the radiator to protect the wall.



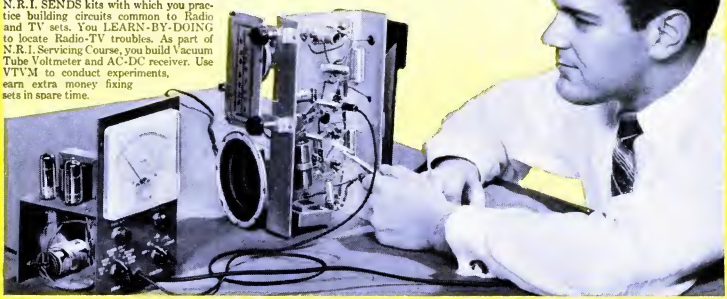
STORE PAINTBRUSHES on a round curtain rod mounted between studs in the garage. Saw off the ball ends so that the rod can be threaded through holes in the handles of the brushes.

Learn Radio-Television

Servicing or Communications

by Practicing at Home in Spare Time

N.R.I. SENDS kits with which you practice building circuits common to Radio and TV sets. You LEARN-BY-DOING to locate Radio-TV troubles. As part of N.R.I. Servicing Course, you build Vacuum Tube Voltmeter and AC-DC receiver. Use VTVM to conduct experiments, earn extra money fixing sets in spare time.



RADIO-TV BROADCASTING (see above) offers important positions as Operators and Technicians. RADIO-TV SERVICING Technicians (see below) needed in every community. Their services are respected, their skill appreciated.

Fast Growing Field Offers You Good Pay, Success, Bright Future

J. E. SMITH
Founder

Bigger than ever and still growing fast. That's why Radio-TV has special appeal to ambitious men not satisfied with their job and earnings. More than 4,000 Radio and TV stations. More than 150 million home and auto Radios, 40 million TV sets. Color TV promises added opportunities. For the trained man, there are good jobs, bright futures in Radio-TV Servicing or Broadcasting.

Training PLUS opportunity is the *ideal combination* for success. So plan *now* to get into Radio-TV. The technical man is looked up to. He does important work, gets good pay for it. Radio-Television offers that kind of work. NRI can supply training quickly, without expense of going away to school. Keep your job while training. You learn at home in your spare time. NRI is the OLDEST and LARGEST home study Radio-TV school. Its methods have proved successful for more than 40 years.

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Soon after enrolling, many NRI students start to earn $10, $15 a week in spare time fixing sets. Some pay for their training and enjoy extra luxuries this way. Some make enough to start their own Radio-TV shops. NRI training is *practical*—gets quick results. Easy to understand, well illustrated lessons teach you basic principles. And you LEARN-BY-DOING by practicing with kits of equipment which "bring to life" things you study.

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NRI has trained thousands for successful careers in Radio-TV. Study fast or slow—as you like. Diploma when you graduate. Mail coupon now. Paste it on a postcard or mail in envelope. ACTUAL LESSON FREE. Also 64 page catalog that shows opportunities, shows equipment you get. Cost of NRI courses low. Easy terms. **NATIONAL RADIO INSTITUTE, Dept. 7JB, Washington 16, D. C.**

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"I was repairing Radios by 10th lesson. Now have good TV job." M. R. LINDEMUTH, Fort Wayne, Ind.

"Doing spare time repairs on Radio and TV. Soon servicing full time." CLYDE HIGGINS, Waltham, Mass.

"I had a successful Radio repair shop. Now I'm Engineer for WHPE." V.W.WORKMAN, High Point, N.C.

"There are a number of NRI graduates here. I can thank NRI for this job." JACK WAGNER, Lexington, N. C.

VETERANS Approved Under G.I. Bills

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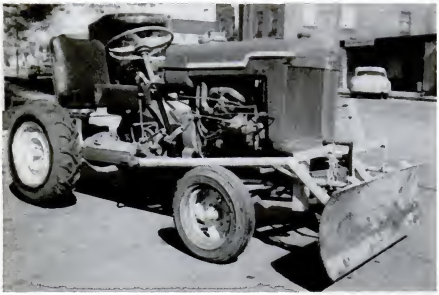
Prize Projects BY PS READERS

Quarter-Scale Steamer. A fix-it shop proprietor with a yen for railroading, Frank Barto of Phoenix, Ariz., put 4,500 man-hours into his nine-ton, one-quarter size model of a Southern Pacific "Daylight" locomotive. Complete to roller-bearing driving boxes and sanders, it chuffs around a mile of circular track on the desert east of Phoenix. Three 20-foot orange-and-black coaches provide seats for 18 passengers.

He Even Made "Stones." A massive three-flue chimney provides both an indoor and an outdoor fireplace for the John Mihalicks of East Liverpool, Ohio. John cast the "stones" of concrete, using molds of three different lengths. The masonry job, including a 26-inch-thick reinforced footing, took two months of hard work but was well worth the effort, costwise. The bill for materials added up to a little under $200.



Tractor from Scrap. Garden plowing, grading and snow removal are a push-over for this 350-pound tractor, assembled from old auto and farm-machinery parts. Builder Bill Gustafson of Genoa, Ill., used a four-cylinder Continental engine from a combine and a Willys transmission to power it. Front and rear axles came from a 1938 and 1951 Plymouth, respectively; the rear wheels belonged to an old plow.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to the Mechanics and Handicraft Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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This amazing $1-a-week offer plus FREE gifts available only by mail—and only from famous THORESEN, Inc., 585 Water Street, New York 2, N. Y., foremost coast-to-coast Remington typewriter distributor and dealer!

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Your typewriter comes in its original factory-sealed carton with Remington's guarantee of Satisfaction, Protection, and Service IN WRITING and is delivered PREPAID. We pay all handling, crating, shipping and insurance costs. You don't pay another cent until 30 days AFTER you receive & are using the machine. Even then you remit only $1 a week, paid monthly. We ship anywhere in U.S.A. Everything done by mail. No salesmen ever call. This is the one and only offer of its kind in America! Thousands of typewriters already distributed to folks. Letters of praise pour in almost daily. "I've earned $22.00!" . . . "Typewriter is beautiful!" "Son's marks up 10 points!"

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SENSATIONAL GOOD NEWS! Now you may have the brand-new, latest-model Remington Quiet-Riter shipped to you by mail for only $1. Yes, just a SINGLE DOLLAR brings you the most modern, most advanced, most beautiful portable in the world—and in your choice of exciting decorator colors!

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What will YOUR children be when they grow up? Tests by leading educators prove that boys and girls who type get up to 38% better grades. Typewritten work is neater, easier to read—and study from! Teachers like to receive typed reports, homework, compositions, etc. A Quiet-Riter is one of the finest investments you can make in your children's future. It inspires them to do even better school work; helps them forge ahead in class after class, become LEADERS! And the Quiet-Riter keeps helping your children in elementary school, in high school and right through college!

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BUILT TO LAST A LIFETIME!

A typewriter will be used by every member of the family for years and years . . . and years! It should be built to withstand rugged use and handling. Don't "sink" your money into cheaper typewriters that make fair start after six months—then bring you aggravation and mounting repair bills.

These models have FEWER keys, FEWER features, are much SMALLER, have INFERIOR construction, and their resale value depreciates fast to "almost nothing." Don't be penny wise and pound foolish! The best is the most economical in the long run. Your Quiet-Riter is built to last, with ordinary attention, a full LIFETIME! What's more, it has higher cash value, HIGHER re-sale value, HIGHER trade-in value. It's favorite among writers, executives, teachers, students, housewives—and small businessmen too!

RUSH $1 Now Before Our Offer Ends!

But you must act now. Even Remington with its vast production facilities cannot keep up with the demand. Mail this coupon below with one dollar.

RUSH ONE DOLLAR FOR TYPEWRITER!

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☐ Gray ☐ Green ☐ Brown

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"I'd like to see them make..."

AN EASY-TO-PUT-ON DOG HARNESS with the buckle at the shoulder. Dogs are aware that the harness means an outing, and do a lot of wriggling.—*William Lurgio, Chicago.*

CAR UPHOLSTERY APPLIED IN LAYERS, so a section could be peeled off when soiled or worn to reveal a new seat cover or door liner underneath.—*Mrs. S. Sorensen, Mira Loma, Calif.*

IMPROVED ELECTRIC JUNCTION BOXES with built-in, insulated terminals. They'd let you splice wires without twisting, soldering and taping them.—*J. W. Linzmeier, Reedley, Calif.*

PAINT-STIRRING SPRAY GUNS with an air-operated paddle wheel to agitate the paint. Heavy pigments wouldn't settle to the bottom as you sprayed.—*Bruce Stewart, Winder, Ga.*

FOOD CANS WITH TOP MARKINGS to give you at least a clue to the contents if a label is torn off. A circle could indicate fruit; a square, vegetables; and so on.—*D. Lucke, Winona, Minn.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What is *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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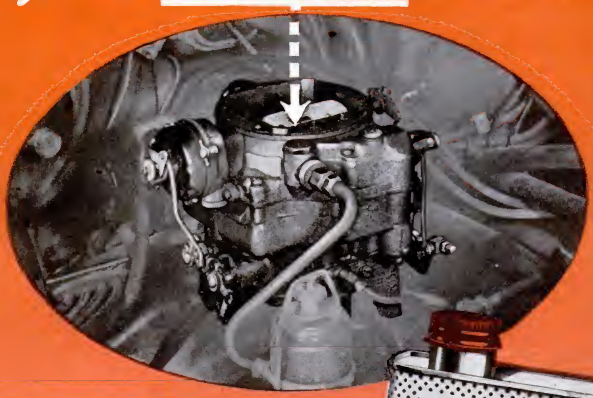
Your carburetor needs a cleanout now!



Dirt, gum and varnish accumulate constantly in the carburetor of every car. And you'll see a big difference when you clean yours. You'll get—

Smoother Idling
Faster Acceleration
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It will save you money, too, in gasoline mileage and repair bills.

Carburetor cleaning is easy with GUMOUT . . . and inexpensive. Simply add GUMOUT to your gas tank. It cleans as you drive. Or your serviceman will run GUMOUT directly through your carburetor while you wait.

Get GUMOUT today from any auto supply store, or wherever automotive products are sold. There's nothing like it!

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Pennsylvania Refining Company, 2670 Lisbon Road, Cleveland 4, Ohio

You ought to know...

The final, delicate part of launching the earth satellite—nudging it off the last rocket stage into just the right orbit—will be accomplished by a device that looks like a Rube Goldberg creation (see sketch). When the rocket's acceleration drops to a pre-set figure, a weight will release a clockwork time fuse. After 27 seconds, this will fire explosives to knock out pins and release a spring. The spring will give the ball a two-mile-an-hour shove away from the rocket (rocket and ball at that point will have hit 17,600 m.p.h.).

What the satellite will do up there has now been settled, too. There will be a series of seven test shots (to be completed any

Drop in acceleration lets weight release timer, firing explosive charge that frees locking pins . . . Spring then shoves ball into orbit

time now) and six real tries (beginning next spring). The six for-real satellites will each carry one of four different instrument packages: (1) ionization chamber to measure the sun's ultraviolet radiation; (2) Geiger counter to monitor cosmic rays, plus gauges on the outside to record impacts with tiny meteors; (3) magnetometer to test the earth's magnetic field, and also an inflatable ball that will be tossed out to check on air density; (4) meteorological devices to measure either heat balance over the tropics or the earth's cloud distribution.

There are six satellites for the four kinds of instrument package in case something goes wrong with any of the firings.

The '58 cars are coming up. The full Edsel story is in this issue, pages 98 and 242. For the others, here's what to expect:

- Ford: completely new engine; very extensive restyling.
- Chevy, Pontiac: both brand-new, bumper to bumper.
- Plymouth and the rest of the Chrysler line: staying with a good thing, making only minor face lifts. There may be two new engines, plus Bendix fuel injection.
- Buick, Olds, Caddy: reported to have new suspension systems.
- Merc: a new line of engines plus sheet-metal changes.
- Lincoln: the world's longest auto, reports say.
- Rambler: gingerbread is off, for a completely new look.
- Studebaker, Packard: a new hardtop plus a Packard version of the Hawk.

A hard look at the young family's money problems by a California social worker has resulted in an up-to-date budgeting scheme (see the chart on page 18) that can help you make your purse match

You ought to know...

your needs. The figures show what percentages of your income should be allotted for different purposes. For instance, if you earn $7,000 a year, you ought to be able to allow $350 to $1,050 a year for installments on a new TV, refrigerator and so on. (Be sure you get the right money in the right bracket, though; car payments belong under transportation, mortgage payments under housing.) The chart is adapted from Frances Lomas Feldman's *The Family In a Money World* ($2.50, Family Service Association of America, 215 Fourth Ave., New York 3) . . . Speaking of budgets, pants for Dad and his sons that wear two-thirds longer, at a price increase of about 25 percent, will be in stores this fall. A new kind of nylon called "420" is woven with cotton (for work pants) and with rayon (for dress slacks) . . . Regular telephone calls at down-to-earth prices from airliners in flight are being tried. Rates: $1.50 to $5.25 for first three minutes.

How much should you spend on what?

Yearly Income	$4,500	$6,500	$12,500
Food	25-35%	20-30%	15-25%
Housing	18-30%	15-25%	15-25%
Clothing	9-13%	9-15%	9-15%
Transportation	7-10%	7-12%	7-15%
Taxes	6-8%	12-15%	20-30%
Health and insurance	7-10%	7-12%	7-15%
Savings	0-10%	0-10%	5-15%
Gifts, education, etc.	4-10%	5-10%	5-15%
Installment payments	5-15%	5-15%	5-15%
Household help	0-5%	0-10%	5-15%

Is the shortage of engineers over? This could affect your job and the jobs your children will have, since practically all work depends on engineering and science nowadays. The professional trend-watchers see signs of an end to the talent drought: (1) It was easier to hire young engineers this spring. Starting salaries were higher than ever, though. (2) Employers are buying less space for help-wanted ads. But though the sizes of the ads are down, the number of ads is up. (3) Maybe the shortage was overdramatized to begin with. A serious scarcity would have forced engineers' pay up more than other salaries. This didn't happen. The true shortage is trained talent—all kinds. Here's why:

Our country is growing, its life is more complex. So we need more and more specialists—machinists, technicians, architects, doctors, administrators—not just engineers.

The big need for engineers is in the production of hard goods: weapons, autos, TV sets, refrigerators. Although the demand for these has leveled off recently, reducing job opportunities, the value of the things and services we produce and the money we have to spend are still near record heights.

So the outlook for engineers *and other* trained specialists is very good, if not as lush as some high-pressure promotion made it seem. As long as the country continues to grow, we'll need more skilled people than we have.

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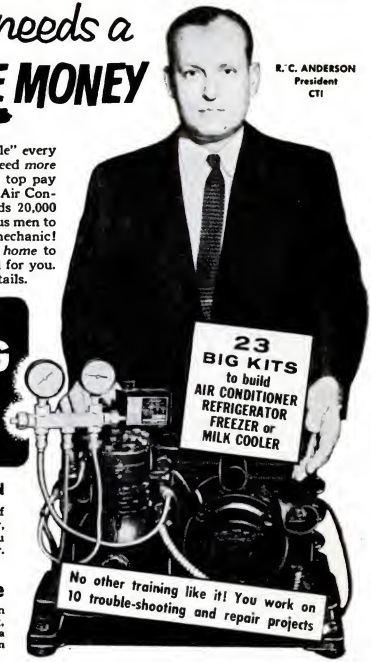
Here's the BEST DEAL YET-

for the man who needs a BETTER JOB-MORE MONEY



R. C. ANDERSON
President
CTI

If you're just "breaking even"... if you're "in the hole" every month ... if your wife wants to look for work—you need *more money*, a *better job!* You can *have* a good job with top pay and security in the old, established, but *fast-growing* Air Conditioning and Refrigeration industry. This field needs 20,000 newly-trained mechanics every year. It needs ambitious men to open service shops. *It needs you!* Don't say you're no mechanic! We know that. We also know *we can train you at home* to become a skilled mechanic. CTI has a real good deal for you. *Just fill in and mail coupon* and we'll rush full details.

NOW YOU CAN LEARN
AIR CONDITIONING
AND REFRIGERATION
by practicing at home with real equipment!

YOU GET "FIELD EXPERIENCE" AS YOU TRAIN

You train at home in spare time. CTI sends you 23 big kits of parts and tools. You assemble a commercial-type, heavy-duty, ¼ h.p. refrigeration high-side (illustrated at right.) Then you build an air conditioner, refrigerator, freezer or milk cooler. All equipment included with training! No extra cost.

You Get Kits Like These

At left is photo of tools included in just *one* kit. You get other tools, tubing, much equipment. Kits are sent on a planned schedule so that you learn in easy stages. You learn fast, too!

In another kit (right) you get motor, fan, pulley, service tools. Kits develop skill, let you get experience, eliminate years of low-pay apprenticeship.

Add to Your Income by Earning Cash as You Train

CTI training is practical, just like working on actual jobs. Like other students, you'll want to do repair work for profit soon after starting. Many students pay their tuition this way, add to their incomes, even get started in a business. Get the facts about this. *Mail coupon.*

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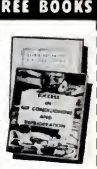

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- Not one battery failed.
- 95% gave better cold-weather starting than required of *new* batteries.
- None of the batteries needed water more than 3 times a year.

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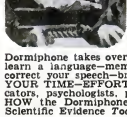

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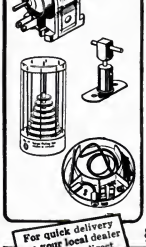

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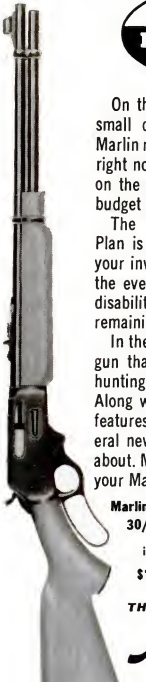

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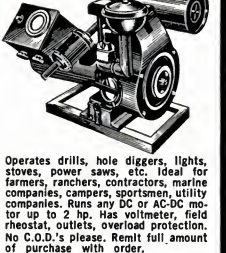

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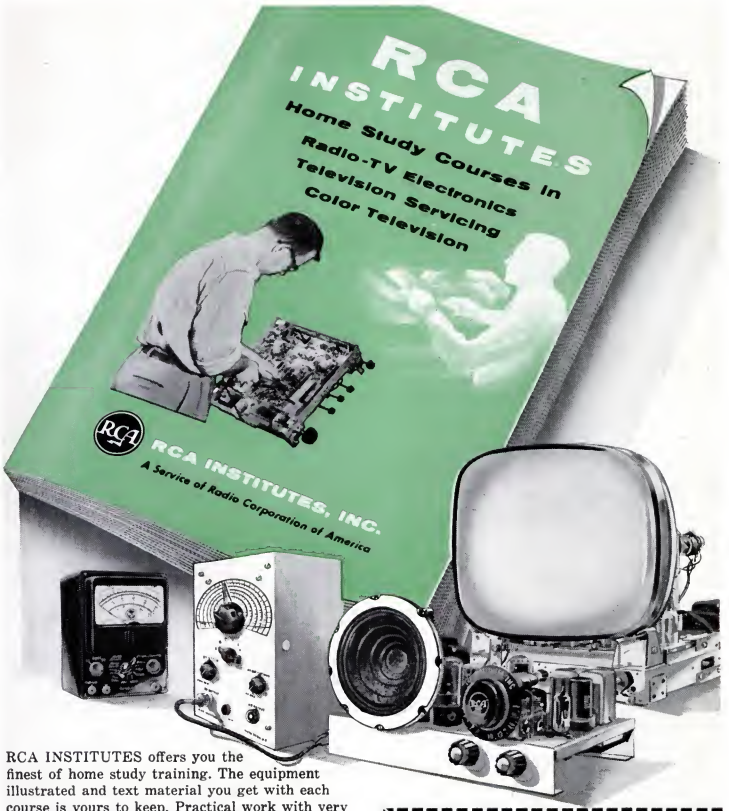

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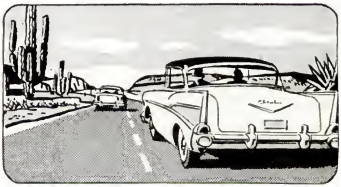

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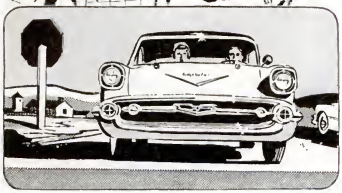

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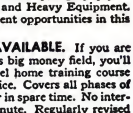

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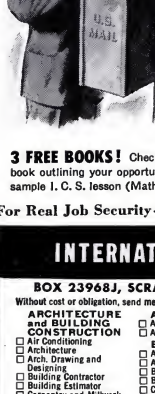

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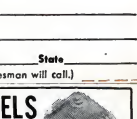

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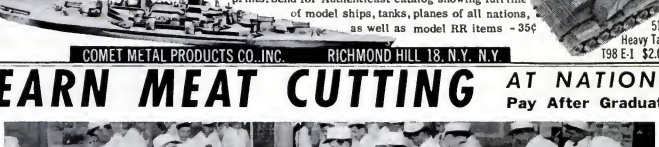

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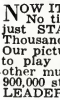

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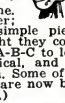

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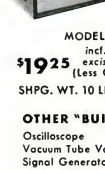

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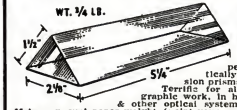

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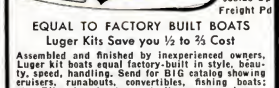

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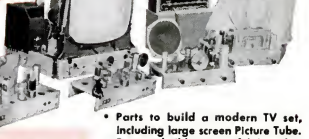

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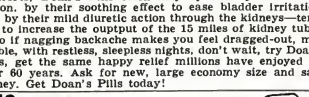

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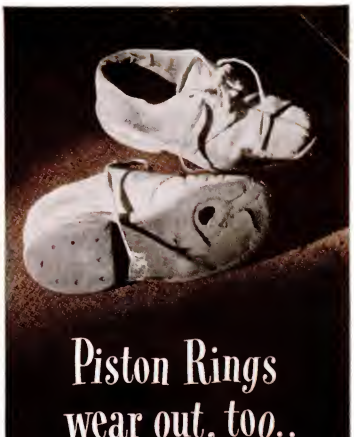

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Get into highly profitable, repeat-order shoe business! Sell new line of Air-Cushion comfort shoes to friends, neighbors, folks at work! Over 210 dress, sport, work, safety shoe styles for men, women. Never sold by stores. Just 2 easy orders a day—in spare time—bring you $117 extra income a month! No investment. Rush name and address TODAY for FREE SELLING OUTFIT. MASON SHOE, Dept. 790 Chippewa Falls, Wis.

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Start your own business at Home... Sharpen Household, Garden and Shop Tools in Spare Time.

Turn spare time Into Big Cash Profits with new Belsaw Sharp-All. No experience needed to sharpen knives, scissors, shears, ice skates, mower blades, hedge trimmers, axes, chisels and circular saws . . . Learn how easily you can start your own spare time business. Amazing low cost easy-payment plan. Send Postcard for **FREE BOOK.**

BELSAW SHARP-ALL CO 708 Field Bldg., Kansas City 11, Mo.

DIESEL

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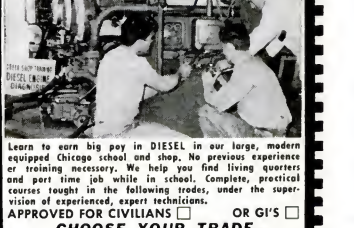

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CHOOSE YOUR ENGINEERING COURSE

These courses are intended as terminal education for men who wish to enter the Diesel-Automotive and Refrigeration-Air Conditioning fields as technicians. These courses are designed to prepare men for supervisory positions. Students with a high school education, or equivalent, will be accepted.

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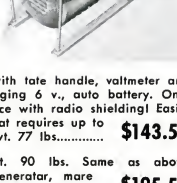

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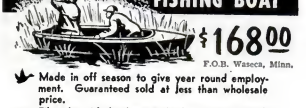

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—Just rush name and address for full free details. If your teeth are loose, we'll tell you how to tighten them. ACT TODAY.

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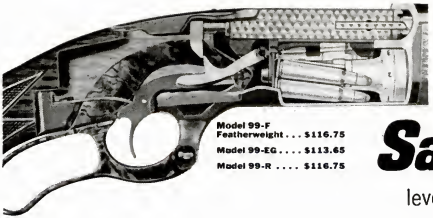

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inside story on the Savage 99

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Exclusive rotary magazine and action are fully enclosed . . . loads and unloads quickly, easily . . . cartridges protected from dirt and moisture . . . balance the same no matter how many rounds in magazine. Unique cartridge count indicator shows number of cartridges in magazine . . . safety indicator tells instantly by sight or touch whether hammer is cocked.

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—and make up to $50 in a day!

Say "goodbye" to tiresome, unprofitable house-to-house canvassing! Sell in **volume** to business men and pocket **volume profits fast!** Customers buy from 1 to 100 uniforms for employees all at one time! You make big money **on the spot!** You'll cash in big, because your line of attractive, well-made Master **advertising uniforms** builds company pride and prestige. Company name or trademark is embroidered right on uniforms—employees become "walking advertisements" of tremendous value to the firm. That's why your prospects buy **fast . . . in volume . . .** again and again! Your profits zoom to new heights in a hurry! And you never invest one cent. We carry the stock; we ship and collect. All you do is show the line and take **Big Profit** orders! Rush coupon now to get—FREE—your powerful Sample Outfit that has everything you need to start making big money right away!

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...that's why we pick the Brand that's made a Name for itself!"

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Spend *confidently* on known quality. Brand Names wear best, work best, taste best, are best.

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Spend *efficiently* on proved value. Brand Names save time "puzzling" over labels, models, prices, etc.

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Spend *smartly* on up-to-date products. Brand Names keep improving, modernizing, introducing new things.

Advertisers in this magazine are good names to know. They're proud of their brands 'cause they satisfy so.

BRAND NAMES FOUNDATION, INC. • 37 Fifth Avenue • New York 16, N. Y.

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Sharpen any mower in 10 to 20 minutes. Hand—Power—Reel or Rotary. Modern is actually two machines in one, a Precision Bed Knife Sharpener and a Precision Reel Sharpener. Extra Bed Knife Grinder is Absolutely Unnecessary. New Mower Support makes it possible to sharpen reel without removing bed knife. The fastest precision lawn mower sharpener on the market. Costs Less. Compare Modern's Many Exclusive Features Before Buying. Send for Free Brochure No. 11 SN

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Run your own profitable 'shoe store' business **from home!** Represent fast growing million dollar firm in spare or full time. We give you—**FREE**—complete Starting Outfit that makes you **$217.00 EXTRA each month for just 2 easy orders a day.** You feature 195 fast-selling dress, sport, work shoe styles for men and women. Air-cushion shoes, many other special features! Sizes 2½–15—widths AAAA to EEEE. Draw on 200,000 pair stock. Also horsehide jackets. Start now selling to friends, folks where you work. Rush postcard for FREE Outfit!

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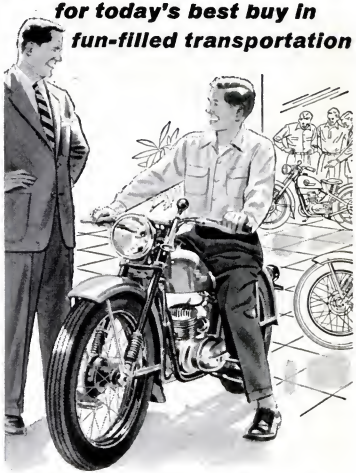
for today's best buy in fun-filled transportation



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Magazine Loading Ammunition Clip — Has Automatic Slide Action — Over 15 Moving Parts

$1.00

Fires 8 Rounds

An automatic full size model of a high powered "45" caliber automatic pistol that looks and feels just like the real thing and contains over 15 moving parts. Loads 8 complete rounds in the magazine clip which snaps into the hard butt just like on army "45". Then fires 8 bullet-like pellets as fast as you can pull the trigger. You've got to see the automatic slide action and feel the power to believe it! Great for shooting fun. This is the most authentic model gun we've ever seen.

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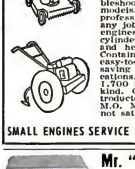
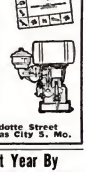
HONOR HOUSE PRODUCTS Dept. PP-60
LYNBROOK, N. Y.

HOW TO FIX ANY AIR COOLED ENGINE!



Save time and money servicing small engines on power lawn mowers, small tractors, industrial applications, etc. SMALL ENGINES SERVICE MANUAL shows how to make expert repairs, tune-up, overhaul or troubleshoot on 200 makes and models. Edited by engineers and professional mechanics. Covers any job on popular 2 or 4-cycle engines. Includes 1, 2 and 4 cylinder models, light weight and heavy duty, 1 to 35 HP. Contains 25,000 procedures, easy-to-follow instructions, time-saving shortcuts, 6,000 specifications. Parts information on 1,700 items. Only manual of its kind. Order NOW at $3.45 introductory price. Send check or M.O. Money refunded if you're not satisfied. Clip this.



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Like Mr. "N" you can profit with KEEP/SAFE—the fine personal safe that undersells all others. Only safe sold direct. 95% of homes, farms and small businesses are prospects. $30 to $71 profit per sale, plus bonuses up to $12 a safe. Choice territory chance to become district agent. **FREE DEMONSTRATOR!** Get details, giving address, including county.

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B-16

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12" long
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Range of 14 colors.
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Suited to every type of building.
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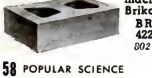

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SENDS—RECEIVES UP TO 10 MILES AS SHOWN with built-in antenna or hundreds of miles with outside antenna! 80 and 40 meter amateur radio bands (novice) also Aircraft and overseas broadcasts (3 to 8 mc.) PORTABLE SELF-CONTAINED POWERED WITH STANDARD LONG LIFE, PORTABLE RADIO BATTERIES. NO AC PLUG-INS NEEDED! Take it with you everywhere you go—on trips, vacations, camping—Keep in contact with home, friends. Has 8 watt crystal controlled transmitter—Sensitive Regenerative Receiver. Send-receive switch. Wt. only 3 lbs. Size, only 6"x7"x3". TESTED—PROVEN—SIMPLIFIED—PRACTICAL—Full information given on quick easy to get license.

SEND ONLY $3.00 (bill, ck, mo) and pay postman $11.95 COD postage on arrival or send $14.95 for postpaid delivery. Complete kit includes all parts, tubes, coils, plastoid cabinet, easy instructions. (Set of batteries—$2.95, crystal $1.25). COMPLETELY WIRED AND TESTED POSTPAID $19.95. A regular $49.95 value—Order now before price goes up.

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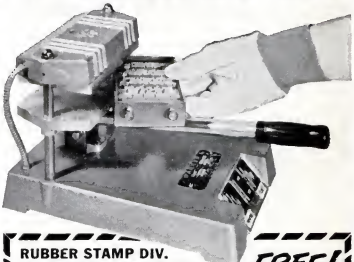
NEW RUBBER STAMP BUSINESS PAYS BEGINNERS UP TO $9.20 AN HR.

START AT HOME IN SPARE TIME with Table Top Machine!



The multi-million dollar Rubber Stamp business—once controlled by a few big companies—is now being taken over by small operators—one in each community throughout the United States. Men and Women who have this inexpensive machine can turn out huge quantities of Rubber Stamps with special wording that buyers once were forced to buy from big cities. Material costing only 27c makes a stamp that sells for $1.80. The machine that does the work is simple and easy to operate and it turns out as many as six Rubber Stamps at a time, each with different wording such as names, addresses, notices, stock numbers, prices and other "copy" needed by offices, factories and individuals. Working full capacity, it can earn as much as **$9.20 an hour for the operator!** Now you can get into the big-pay business yourself, with your own home as headquarters. You don't need experience. We supply everything, including complete instructions and eight ways to get business coming in fast. Start making up to $9.20 an hour from the very beginning. Cash in on the profitable Rubber Stamp business in your community, right away. We'll mail full particulars FREE and no salesman will call. Be first in your locality. Rush coupon today or send your name on postcard to

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FREE!

Please rush full particulars about the little machine that can get me started in the profitable Rubber Stamp business at home in spare time. Everything you send me is FREE and no salesman will call.

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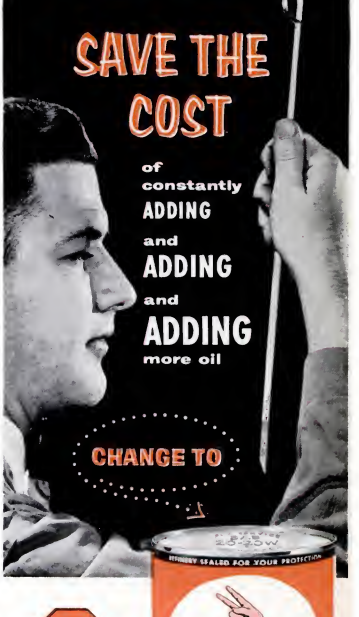

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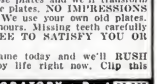

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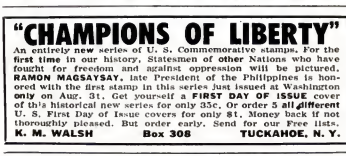

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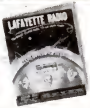

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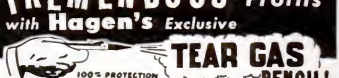

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It is a "grass" relative to the lily with paper thin blades 1/16" wide. This sod-forming EVERGREEN, low-growing oriental genus is currently used by many owners of distinctive homes in America for lawn grass. Now we can offer this exclusive Blue-Green Mondo "Grass" at popular prices.

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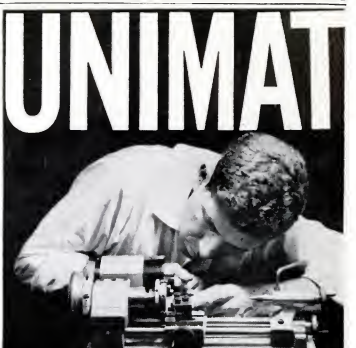

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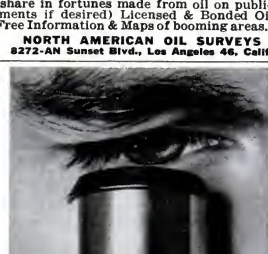

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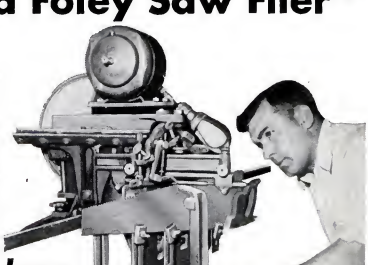

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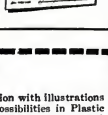

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Advertising, Agencies for Advertisers... 53
Agents Wanted ... 43
Air Conditioning ... 7A
Antiques, Relics & Indian Good ... 20
Artists Supplies ... 76
Authors Service ... 52
Auto Supplies & Equipment ... 2
Auto Trailers ... 3
Automobiles & Midget Car ... 1
Aviation ... 5
Batteries, Generators, Etc. ... 6
Boats, Outboard Motors ... 11
Body-Building Courses, Jiu Jitsu, Etc. ... 12
Books & Magazines ... 23
Build It Yourself ... 66
Business Opportunities ... 37
Business Service, Information, Name Lists ... 50
Buy It Wholesale ... 38A
Cameras, Photo Supplies ... 34
Camping Equipment & Tents ... 16
Cartooning, Sign Painting, Chalk Talks ... 54
Chemistry & Physics ... 41
Coins & Currency ... 26
Color Photo Finishing ... 32A
Contests ... 46
Detectives ... 47
Dogs, Birds, Hamsters & Pets ... 17
Earthworms ... 18
Educational & Instruction ... 45
Electrical Supplies & Equipment ... 7
Enamels, Paints & Varnishes ... 64A
Engines, Motors, Etc. ... 10
Farms, Other Real Estate ... 19
Field Glasses, Telescopes ... 14
For Inventors ... 60
For Sale Miscellaneous ... 7
For the Home ... 69
Formulas, Plans, Etc. ... 39
Games & Entertainment ... 24A
Geiger Counters, Treasure Finders ... 77
Help Wanted ... 42
High-grade Salesman ... 4
Hobbies, Collections ... 31
Home Craftsman ... 65
Hypnotism ... 24
Inventions Wanted ... 61
Language Outfits ... 48
Machinery, Tool Supplies, Etc. ... 9
Magic Tricks, Puzzles, Etc. ... 25
Manufacturing ... 69
Minerals & Precious Stones ... 30
Miscellaneous ... 79
Models, Model Supplies ... 63
Moneymaking Opportunities ... 38
Motion Pictures, Slides, Sound Equip. ... 33
Motorcycles, Bicycles & Supplies ... 4
Music, Song Writers & Records ... 35
Of Interest To Women ... 70
Old Gold, Jewelry, Watches ... 67
Old Stamps Wanted ... 27
Patent Attorneys ... 59
Patents For Sale ... 62
Personal ... 80
Photo Finishing, Photocopies, Etc. ... 32
Plastics ... 40
Play, Sports, Etc. ... 49
Poultry & Supplies ... 21
Printing, Mimeographing, Etc. ... 57
Printing Outfits, Supplies ... 58
Profitable Occupations ... 36
Radio, TV, Supplies & Equipment ... 36
Razor Blades, Shavers ... 74
Rubber Stamps & Office Supplies ... 56
Special Services ... 51
Sporting Goods, Guns, Fishing Tackle, Etc. ... 15
Stamp Collecting ... 28
Tattooing Supplies ... 75
Tobacco & Pipes ... 68
Trees, Shrubs, Seeds & Herbs ... 19
Typewriters & Office Machines ... 55
Wanted to Buy ... 72
Watch Repairing ... 78
Wearing Apparel ... 73
Welding, Soldering ... 8

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DIES made, small intricate designs. blanking, trimming. Vice or press actuated. 2x3" approx. $30.00. Dimaco, 1511 Gernand, Danville, Illinois.

64 MODELS, MODEL SUPPLIES

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SHIP Models. Most complete line in New England. Kits, fittings, plans, books, tools, engines, motors, 1958 illustrated catalog 25c. James Bliss and Co., Inc. Dept. PS. 342 Atlantic Avenue, Boston 10, Massachusetts.

LIONEL Trains. Big Discounts. Bulletin Free. Catalog 25c. Mack Brothers, 2041 Chicago Ave., Chicago 22.

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"ST" Steam engine castings, fittings, boat plans catalog 15c. Ship Models Ltd., 186 Summer, Andover, Mass.

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72 WANTED TO BUY

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TOP prices paid for old copies of Popular Science—need only issues from period 1890 to 1915. If books are complete, even though condition is not perfect, please write us and describe what you have. Do not send the issue until you hear from us. Write to Box 308. Tuckahoe, New York.

QUICKSILVER, Sterling, Silver Solders, precious metals. Mercury Terminal, Norwood, Massachusetts.

77 GEIGER COUNTERS & TREASURE FINDERS

FIND Buried Treasure, gold and silver, with Goldak's sensational 3½ lb. "Find-It" locator, only $64.50. Write for free literature on complete line of mineral, metal locators, Geiger and scintillation counters. Goldak, 1540 W. Glenoaks Blvd., Glendale, California.

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FOR Treasure Locators, Geiger, Scintillation Counters, Mineralights, M-Scope. Fisher Research Laboratory. See Advertisement, Page 000.

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TREASURE Locators. Free Literature. Sierra Scientific, 215 York, PS18, Los Angeles 42, California.

FREE Literature—Lightweight, guaranteed Metal Detectors. Geiger Counters and Mineralights. Kits and Assembled Models. Electronic Applications, Dept. S, Box 8, Arlington 10, Virginia.

78 WATCH REPAIRING

WATCH and clock repairing books. Free catalog. North American, 2320-BK, Milwaukee, Chicago 47, Illinois.

WATCHMAKERS' — Jewelers' — Machinists' Tools. Watchmaking Course. Catalog 25c. Bengal, Culver City, Calif.

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MIRROR one side; transparent other side. Photograph people unawares. 8" x 10", $2.00. 18" x 20", $5.00. One-Way Mirror. PS-957, Box 625, Mt. Vernon, New York.

GOOD jobs, opportunities galore in Metropolitan St. Louis, "Gateway to the West." Largest Sunday classified airmailed, $1.50. Fool your friends—remails from Flat River, Missouri, Ozark hillbilly center and "Lead Mining Capitol of the World." 25c. Expeditor, Box 726, Flat River, Missouri.

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80 PERSONAL

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COLDS Controlled. Original Report, $2. Kendez, Box 176, Cicero, Illinois.

OPPORTUNITIES—Los Angeles. Classifieds $1.00. Ziegler, 1082 Gladys, Long Beach, California.

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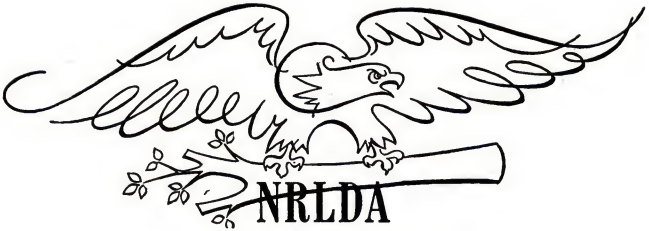

ANNUAL FALL HOME IMPROVEMENT PROGRAM

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NRLDA

National Retail Lumber Dealers Association
18th & M Streets N. W., Washington, 6, D. C.

Lofty Enlarger Blows 'Em Up Big

You can make whopping big blowups if you mount your enlarger on the ceiling as I did. I have a table under it that holds the easel for regular work. By moving the table aside I can project down to the floor. The ceiling mount is steady, eliminating jars and vibrations that often fuzz images.

The enlarger column can be quickly removed from its base and bolted to a cleat across two ceiling joists, or it can be suspended from a husky wall bracket if the room has extra high ceilings. When I have finished working, I just slide the enlarger up, and it's out of the way.—*C. G. Bucher, White Plains, N. Y.*

Wire Paddle Mixes Paste

Instead of mixing wallpaper paste with my hands, I use a paddle made by bending down the ends of a metal coat hanger. This wire stirrer beats up a smooth, lumpfree paste, and I can start papering without a messy cleanup job.—*C. F. Stankoven, Elkhart, Ind.*

Food Colors Tint Photo Prints

Sparkling color tints can be added to black-and-white photo prints by dunking them in water mixed with a few drops of food coloring. Let them soak for five minutes; then blot and dry them. Before you submerge your best enlargements, experiment with a few small prints to determine how much coloring is needed to get just the tint that pleases you.

Plaster Is Soldering Clamp

Metal parts can be held firmly in alignment for soldering by bedding them in "investment" plaster—available at dental-supply houses. Mix the plaster with water as directed on the can. When it thickens, pour it onto a sheet of glass. Arrange the metal parts as the plaster sets. After soldering the assembly, free it with a knife.—*Hugh Botts, NYC.*

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Hot Music Goes in Cold Box

A HI-FI fan on a budget, I salvaged two ancient iceboxes and housed all the parts of my set in solid oak.

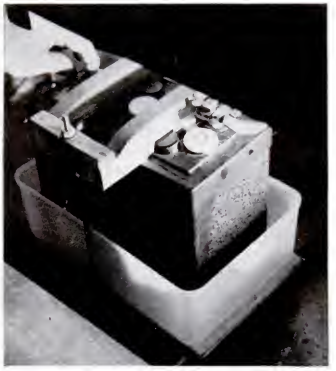
I mounted the turntable in the top of an upright box and cut out a panel below it for my FM. Two shelves inside the lower door hold a pre-amp, 45-r.p.m. changer and an AM tuner. Wires go down the drain to the amplifier on the floor.

A low ice chest (below) fitted with a partition holds records. The hinged lid folds back to open one side or lifts off entirely.—*D. K. Slifer, Woodbury, N. J.*

LOW ICE CHEST has an off-center partition to make compartments for 10″ and 12″ platters.

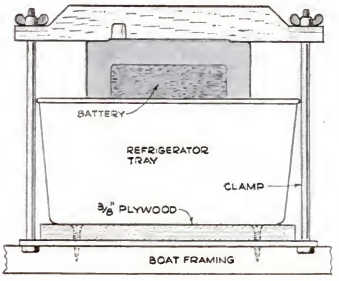
▶▶▶A closet within a closet may be the answer if you're short on space for storing woolen blankets and out-of-season clothing. Many older homes have a walk-in closet, one side or the back of which can be partitioned off and made into a cedar compartment. A two-piece door hinged down the middle may be needed for space reasons. Be sure it fits tightly and can be kept shut through the season.

▶▶▶SAVE scraps of perforated hardboard for your redecorating kit and you'll have convenient holders when painting bolt-on objects like drawer pulls and cabinet handles. Slip their bolts through the hardboard holes and secure them with nuts. That way, you won't have to handle the objects themselves during painting and drying.—*T. L. Jones, Kearny, N. J.*



Plastic Encases Boat Battery

THE light, acid-proof case for my boat battery used to be a plastic refrigerator bin. It sits on a plywood base screwed across two of the boat bottom's frame members. A wooden bridge over the battery is clamped with two long bolts to a wood strip under the base. A U bolt could have been used for the clamping, too.—*E. F. Lindsley, North Prairie, Wis.*



There's an easy answer to this tough storage problem

Let MASONITE® Heavy Duty PEG-BOARD® put garage walls to work

You can have 33% more storage space with ¼" heavy-duty Peg-Board panels and accessories for as little as $27.00.* Clever slip-in-a-hole fixtures support just about anything—your heaviest garden tools, shelves and equipment, bench top and hand tools—and there you have it, a Working Wall! Enjoy a neat, attractive garage, and quickly, too; just ask your building materials dealer about heavy-duty Peg-Board panels and fixtures. Mail the coupon below for other interesting ways to use Peg-Board products.

***Wall area 8′ x 12′. Heavy-Duty ¼" Peg-Board Panels $24.60. Accessories $1.96**

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Please rush me a copy of the "Home Owners' Guide to Masonite Peg-Board Panels and Fixtures."

Name.....

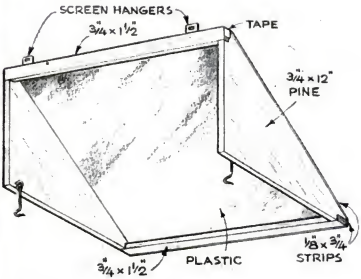
Address.....

City.....*State*.....

Zone.....*County*.....

Bark on Tape Warns Off Thieves

After several burglaries, one store owner put in a new kind of alarm—a tape recording of a barking dog. A switch is concealed by a rubber-mat step plate that closes a low-voltage circuit. This operates a relay that turns on power to start the recorder. When the shop is locked up at night, the recorder is set to "on" and the volume is turned up high. Potential burglars, hearing the vicious bark with its threat of immediate action, take off fast. He's had no further trouble with night callers.—*Henry Josephs, Gardenville, Pa.*



Awning Lets in Winter Air, But Sheds Rain or Snow

Hang a rain awning on the screen fixtures outside your bedroom window and you can have fresh air even on wet or snowy nights. Make it of translucent plastic on a wood frame, keeping the width that of the screen the unit replaces.

Cut the sides at 45 degrees and notch the upper and outer corners to take cross braces. Glue and nail the supporting braces in place, fasten screen hangers to the front of the upper brace, and give the wood frame two coats of outdoor paint.

Fasten the plastic to the sloping framework with rustproof tacks, and brad molding to the edges on three sides. Run adhesive tape over the plastic on the top cross brace, carrying it overside, and tack it down. Paint both molding and tape.

A hook fitted into an eye on the parting strip of the window will keep the unit from blowing upward and banging in windy weather.—*W. H. deFontaine, NYC.*

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Please send me more information on my opportunities for enlisting in the U.S. Air Force. I am between the ages of 17-34 and reside in U.S.A. or possessions.

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Address_____ Age_____

City_____ Zone____ State_____

You'll never outgrow a Kodak Retina Camera!

Two great Kodak Retina models to choose from—each the heart of a *complete system* of photography...

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Ask your photo dealer to demonstrate the host of exciting picture-taking features that are available *only* in the Retina. And ask, too, about the wonderful family of special Kodak Retina Photo Aids described on the next page. They'll open the doors to a lifetime of new picture-taking adventures.

Kodak Retina IIc Camera *f*/2.8, $132 —*or as little as $13.20 down*. Retina IIIc Camera, *f*/2 with built-in exposure meter (shown above), $175—*or as little as $17.50 down*. See these famous Kodak Retina Cameras *soon*.

From table-top close-ups to telephoto views . . .

These—and many other—Kodak Retina Photo Aids will help you enjoy new adventures in picture taking!

Kodak Retina Curtar Lens Component, 35mm f/5.6—Takes only a jiffy to switch to this lens component for wide-angle views indoors, panoramic shots outdoors. Focuses 2½ feet to infinity, **$59**

Kodak Retina Longar Lens Component, 80mm, f/4—R-e-a-c-h-e-s across space for telephoto close-ups of distant scenes, candid shots of children and pets. Focuses from 6½ feet to infinity, **$80**

Kodak Retina 35-80 Optical Finder—Fits clip on top of camera to show field covered by 35mm and 80mm lenses. Complete with leather case, **$15.50**

Kodak Retina 50-80 Sports Finder—Folding, open-frame finder shows field of action covered by 50mm and 80mm lenses. With leather case, **$8.25**

Kodak Retina Close-Range and Viewfinder Kit, Model B—Two auxiliary lenses for short-range photography, plus parallax-correcting viewfinder combined with rangefinder to fit clip on top of camera, **$36.50**

Kodak Retina Close-up Kit, Model B—Wonderful for hand-held close-up work. Complete with field-guide holder, field guides and auxiliary lenses for picture taking from 4 fixed film-to-subject distances from 11¼ down to 5 15/16 inches, **$42.50**

Kodak Retina Microscope Adapter Kit, Model B—Contains everything needed to adapt a Retina to nearly any microscope for producing photomicrographs, **$62.50**

Kodak Retina Flasholder Bracket—Complete with cords and tips for attaching your choice of a variety of Kodak and Kodalite Flasholders, **$2.95**

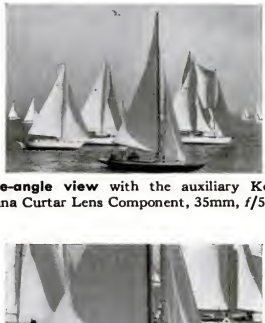
Kodak Retina Field Case, Model B—Fully protects your camera, yet keeps it ready for instant action. Finest quality top-grain cowhide, metal trimmed and reinforced, **$14.50**

Many other Kodak Retina Photo Aids are available—filters, lens hoods, lens hood extension, filter cases, etc. See your photo dealer.

Prices are list, include Federal Tax where applicable, and are subject to change without notice.

Close-up made with one of the field guides and auxiliary lenses in the Kodak Retina Close-up Kit

Regular view with the Kodak Retina 50mm lens that comes with the camera



Wide-angle view with the auxiliary Kodak Retina Curtar Lens Component, 35mm, f/5.6

Telephoto view with the auxiliary Kodak Retina Longar Lens Component, 80mm, f/4

Kodak
TRADEMARK

EASTMAN KODAK COMPANY, Rochester 4, N.Y.

All About Ford's Luxury-Loaded Edsel

Rear running lights form gull wing, with turn signals outboard. Backup lights are below lid.

Whopping-big engines power four lines of cars with gadgets galore, styling that reverses a trend to horizontal grilles

By Devon Francis

AFTER six years of mulling things over and three years of active work, the Ford Motor Co. last month finally took the wraps off its new medium-priced automobile, the Edsel. Then everybody concerned, from President Henry Ford II on down, sat back hopefully, and apprehensively, to see how much of a stir their glittering piece of hardware would create.

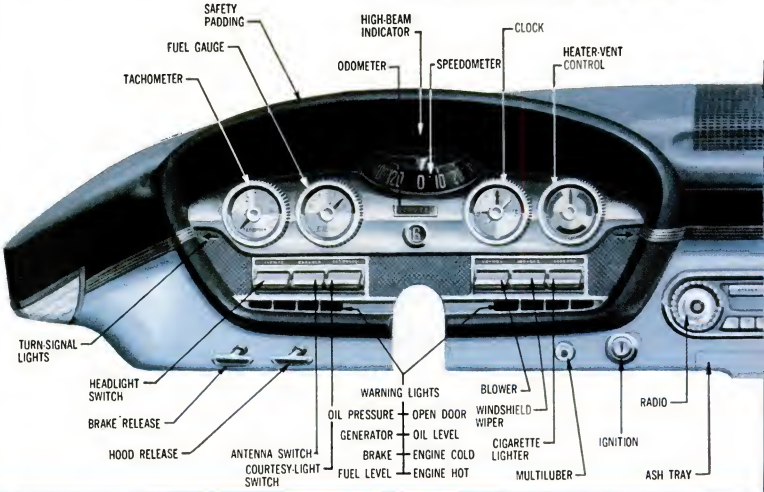
They needn't have worried. Millions of people wanted a look. A well-calculated series of "leaks" on features of the Edsel for months prior to its introduction paid off in public interest. The car had been,

WIDTH of 79.8 in. for Corsair and Citation models exceeds that of most competitive cars.

REAR FENDERS are sculptured, finless. Trim combinations are designed to prevent possible color "clashes."

BULGE IN HOOD is intended to better the driver's "sense of direction."

Array of instruments and controls in narrow panel area resulted from studies to keep



thanks to this, Detroit's worst-kept secret.

Still, what people saw when they looked was a shocker. The car has all this:

- More engine power than the average motorist will know what to do with.
- Gadgets beyond a gadgeteer's dreams of glory.
- Styling that reverses the years-long trend to horizontal-pattern front ends, and chrome enough to tax the output of the world's mines.

The first complete line of cars under a new name in a decade, the Edsel—to use a horse-breeding term—is by Jaguar out of Alfa Romeo. Of the two engines available, the *smaller* has practically the same cubic-inch displacement as the current Buick, Cadillac, Chrysler Saratoga, Lincoln or Packard Clipper. The bigger is bigger than the biggest of all other passenger-car engines now on the market.

The respective horsepowers: 303 and 345.

Why so much power? One Edsel executive, surprised at the question, replied, "I haven't heard the reasons discussed."

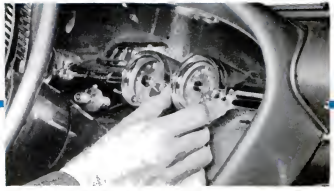
They're obvious in the performance, though. The car takes off like a gazelle one jump ahead of a drooling lion. There are four "lines" or series. The lower two lines,

Five station wagons, in six- and nine-passenger versions, are among Edsel's 18 models.

everything easy to see or reach

PUSHBUTTONS for transmission, centered on steering wheel, actuate electrical relays.

MINIMUM OF STRETCH gives access to heater dial, parking-brake release (foot-applied), hood release, headlight and other switches. Speedometer resembles a ship's compass in binnacle mounting. Tach, of course, is optional.



HEATER-DEFROSTER CONTROLS (air-conditioning is optional) are combined except for blower.

the Ranger and the Pacer, fitted with the smaller engine, accelerate from zero to 60 miles an hour in 9.5 seconds.

That's 2.1 seconds better than the 1957 Buick Special, a second better than the Chrysler Windsor, 1.1 better than the Olds Super 88. It matches the Pontiac Super Chief.

The top lines, the Corsair and the Citation, with the bigger engine, reach 60 from taw in 8.8 seconds.

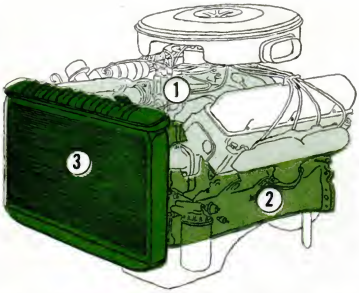
In deference to various state legislators —who are brooding about limiting horsepowers by law—the Edsel's top speed must remain sh-sh.

As shades of things to come, the smaller engine has "an interchangeability of block" with the plushier 1958 Fords.

The car's ride matches its acceleration. The Edsel is cat-footed, solid on the straightaway, and as upright as an archbishop on the hard turns. The ride of the top two lines is a trifle softer than that of the Ranger and Pacer.

The Edsel's gadgetry—mostly optional

CUSHIONS ARE SPLIT, one-third for driver, two-thirds for passengers in two-door hardtops.



FOR QUICK WARMUPS, coolant in 345-hp. engine circulates in stages—first in cylinder heads and around intake manifold, then in block, finally in radiator. Thermostats are set for 140 degrees F.

BRAKE SHOES automatically compensate for wear when pedal is depressed in backing up. Lever, triggered by cable and spring, rotates ratcheted adjusting screw.

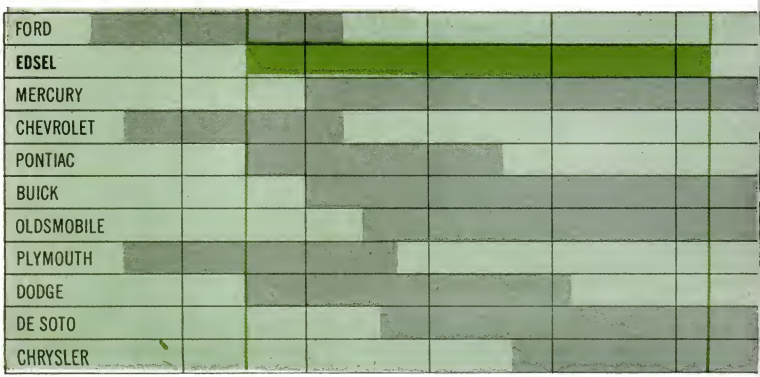
at extra cost—starts under the hood, where a warning is flashed to the instrument panel when the engine needs oil, and winds up at the deck lid, where a solenoid releases the lock at the turn of a key from the driver's seat.

The most prominent of the gadgets is the circle of pushbuttons in the center of the steering wheel to operate the automatic transmission. Two safety features: The transmission can't be shifted out of P-for-Park if the ignition is off, and it won't go into R-for-Reverse at a speed beyond that required for rocking the car in snow or mud.

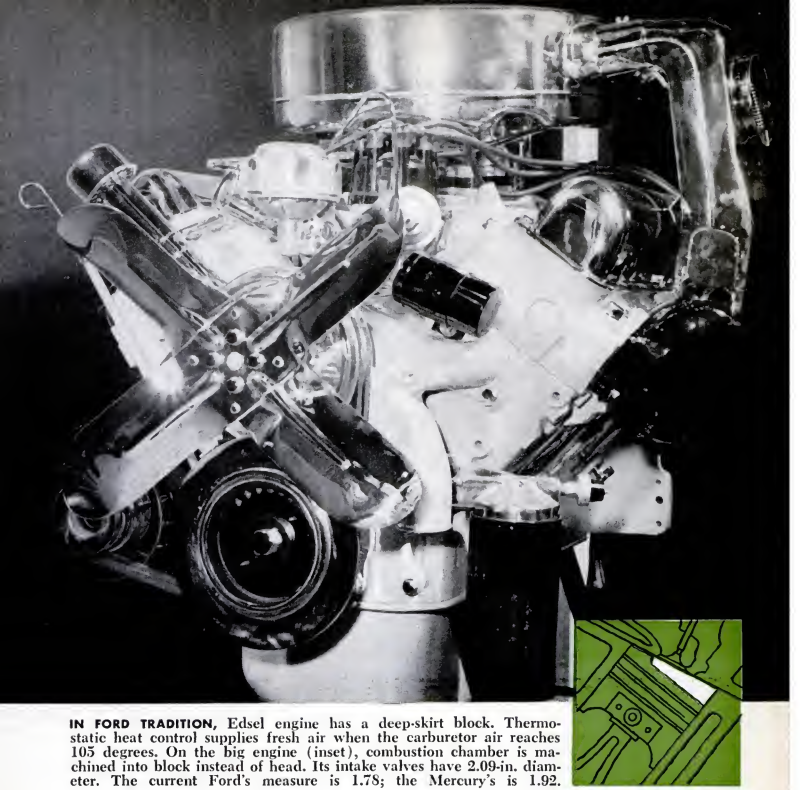
There's lots more. For fast warmups in cold weather, the circulation of water in the cooling system of the big engine is in three stages. It starts in the cylinder heads and through thermostatic valves spreads progressively to the block and the radiator as it warms.

The brakes automatically adjust themselves for wear.

Doors can be locked by remote control to keep moppets from falling overboard.



EDSEL'S FOUR LINES of cars are priced to overlap costliest Chevrolets, Fords and Plymouths, blanket Pontiac and Dodge, and cover most of Mercury, Buick, Olds and De Soto models.



IN FORD TRADITION, Edsel engine has a deep-skirt block. Thermostatic heat control supplies fresh air when the carburetor air reaches 105 degrees. On the big engine (inset), combustion chamber is machined into block instead of head. Its intake valves have 2.09-in. diameter. The current Ford's measure is 1.78; the Mercury's is 1.92.

Heating, cooling and defrosting controls are combined on the knurled rim of a single panel dial. Just turn it.

A flasher light warns the driver when he is exceeding any speed that he presets on the speedometer.

There are louvered vents at the base of the windshield to direct incoming air up or down. On the panel there's a tachometer, an oil-pressure-is-low (in addition to a you-need-oil) light, a you-need-fuel light, a brake-is-on light, a door-is-open light, an engine-is-cold light and an engine-is-too-hot light. Naturally, all the old-hat stuff like power antennas and one-shot lubers are added to power brakes, power steering, power seats, power windows and automatic transmissions as additional options.

All this is the new Edsel—named for the late father of the three Ford boys, Henry, Benson and Billy—but it was on the styling that the company tycoons spent restless nights. It was decreed at the start that tail fins were out.

"We reached that decision fast," Dick Krafve, Edsel's general manager, told POPULAR SCIENCE. "We knew that by the time we got cars into showrooms, everybody in the industry would have fins. We had to be different."

[*Continued on page 282*]

How Disaster Strikes

Air crashes and tornadoes are up, railroad wrecks down, but auto disasters—though "minor"—still take the most lives

By Max Gunther

ON SEPTEMBER 8, 1900, exactly 57 years ago this month, a tropical hurricane churned northward into the Gulf of Mexico. With colossal fury it ripped into Galveston, Tex. Massive sea waves rolled inland, completely flooding Galveston Island. Some 5,000 people were killed. It was the worst disaster in U. S. history.

Disasters of that magnitude are rare. But each year in the U. S., there are roughly 100 disasters that take five or more lives apiece. There are usually at least four that cause 25 or more deaths each. And thus far in the 20th century, disasters killing 100 or more have occurred in two out of every three years.

There's no hard definition of a disaster. Insurance statisticians, generally speaking, call an incident a disaster if it takes

Old prints depict vividly great disasters of the past

THE GENERAL SLOCUM BURNS: More than 1,000 people died in the fire or drowned when flames broke out in the engine room of this crowded New York excursion boat on June 15, 1904.

CHICAGO FIRE: Supposedly started when Mrs. O'Leary's restless cow kicked over an oil lantern, the great fire of Oct. 8, 1871, took 300 lives and destroyed 17,000 buildings.

WORST DISASTER in U. S. history: On Sept. 8, 1900, a tropical hurricane struck Galveston, Tex., and a massive tidal wave inundated the city. More than 5,000 people were killed.

five or more lives. It's a "minor disaster" if it kills fewer than 25 people, a plain "disaster" if 25 to 99 die, and a "major disaster" if its toll is 100 or more.

Disasters are capricious. There's no way of telling when or where one will hit. Even so, like other random occurrences, disasters form long-range patterns and trends. By looking at these patterns, you can tell, in a general way, what kinds of disasters to expect.

By far the worst kind, in terms of killing and property-damage potential, is a hurricane. In No. 2 place among this century's disasters, under the Galveston storm, is another hurricane that blasted across Florida in 1928. It killed 1,836. The all-time property-damage record among U. S. disasters is held by a third hurricane. This is "Diane" of 1955, which destroyed about $1½ billion worth of property along the Atlantic Coast.

The second-worst kind of disaster is a fire. The most tragic fire in all U. S. history was one that surrounded, trapped, and killed 1,152 people in Peshtigo, Wisconsin, on October 8, 1871. On that same day, in Chicago, a restive cow supposedly kicked over a lighted oil lantern in a barn. The result was the famous Chicago fire, which took 300 lives and 17,000 buildings.

The worst fire of this century took place in the summer of 1904. The excursion boat General Slocum, jammed with people, was returning to New York City after a day's outing when a fire started in the engine room. Flames spread swiftly through the craft; and though the captain was able to run it ashore, more than 1,000 people drowned or died in the fire.

Another major fire disaster occurred in the fall of 1942, when flames licked up a set of wall decorations in a Boston night club, the Cocoanut Grove. The fire itself was not serious, but the resulting panic jammed people against the doors and kept firemen out. The toll: 492. Two years later, as 6,800 people watched a circus at Hartford, Conn., fire leaped up the big top and within 10 minutes brought the huge tent flaming to the ground. More than 150 lost their lives.

Taking third place: tornadoes. Though they're perhaps more terrifying than hurricanes because you can see their physical outlines, and though they pack winds of far greater power, tornadoes seldom spread damage over a large area. The worst tornado disaster of this century occurred in the spring of 1925 when a group of eight twisters mowed northeastward from Missouri to Ohio, killing 792.

Railroad and aircraft accidents rank fourth in disaster potential. So far in this century, only one train wreck and one airplane crackup in the U. S. have reached major-disaster proportions. The train wreck occurred at Nashville, Tenn., in 1918; it killed 101. The plane crash happened last year when two airliners collided over the Grand Canyon and plunged 128 to their deaths.

Fifth in this grim ranking are motor-vehicle accidents. At no time has any auto or bus accident in the U. S. taken as many as 100 lives. It's rare, in fact, that highway smashups take more than 25.

But when you consider the frequency with which each kind of disaster occurs, the ranking changes. Though motor-vehicle accidents are almost always "minor" disasters, they cause more deaths, added up, than any other kind of catastrophe. Over the past few years, minor highway disasters have occurred in the U. S. about once a week. On the other hand, there has never been a year in recorded history when more than four hurricanes hit.

In a survey by the Metropolitan Life Insurance Company of all disasters that occurred from 1951 to 1955, auto accidents headed the list. Next in order came those from weather, fires, aircraft crackups, and train wrecks.

This isn't the same picture that held a decade earlier, and it won't be the picture 10 years hence. Important long-range changes are foreseen.

Despite the devastation of Hurricane Audrey, which just this summer smashed the town of Cameron, La., with a loss of several hundred lives, many meteorologists expect fewer hurricanes to hit the U. S. in the next decade or two. According to Keith Veigas, meteorologist of the Travelers Insurance Company Weather Research Center, the earth goes through constant heating and cooling cycles. We now seem to be heading into a 40- or 50-year cooling period. "As the Equator becomes relatively cool," says Veigas, "the westerly winds that bring hurricanes to North America will shift further south. Thus, what hurricanes do develop won't be as likely to drift this way."

Decreased sunspot activity also will

WOODBRIDGE, N. J., FEB. 6, 1951: Worst railroad wreck of recent times occurred when a commuters' train hurtled off a temporary wooden trestle—last stop for 81 passengers.

IN WAKE OF HURRICANE DIANE, in Aug., 1955, a raging torrent swept through Torrington, Conn. In northeast U. S., Diane cost 191 lives, almost a half-billion dollars in damage.

Major U.S. Disasters in the 20th Century

YEAR	DISASTER	DEATHS
1900	hurricane	5,000
	fire	326
1903	fire	602
	fire	170
1904	fire	1,030
1908	fire	175
	tornado	100
1909	hurricane	350
1911	fire	145
1915	hurricane	275
1917	tornado	101
	explosion	133
1918	fire	559
	railroad	101
1919	hurricane	284
1925	tornado	792
1926	hurricane	1,000
1928	hurricane	1,836
1930	fire	320
1932	tornado	268
1934	fire	125
1935	hurricane	376
1936	tornado	216
	tornado	203
1937	explosion	294
1938	hurricane	600
1940	fire	207
1942	fire	492
1944	explosion	322
	explosion	130
	fire	168
	tornado	150
1945	tornado	102
1946	fire	119
1947	explosion	570
	tornado	169
1952	tornado	208
1953	tornado	114
	tornado	116
1954	explosion	106
1955	hurricane	184
1956	air accident	128
1957	hurricane	500

Does not include military action, ships except when in U.S. ports, aircraft except when over U.S., or mine disasters. Since 1900, major mining disasters have accounted for a loss of 3,600 lives.

Sources: National Board of Fire Underwriters, Metropolitan Life Insurance Co., National Safety Council, U. S. Dept. of Commerce Weather Bureau, Information Please Almanac

keep down the total of hurricanes in the U.S., says one weather expert.

Not only that—when hurricanes do veer northward, we're likely to be warned more precisely of their coming. Meteorologists such as Veigas and Dr. Thomas Malone, director of the Travelers Weather Center, have been experimenting with electronic computers in short-range weather predictions. Dr. Malone is now ready to tell any U. S. town what the mathematical odds are that any one hurricane will drift that way. Thus forewarned, citizens may be able to stem disaster.

No one is ready to make predictions about tornadoes. Meteorologists have no complete history of tornadoes to work with, for they can easily occur in sparsely settled areas without being reported. In recent years, there has been a huge apparent increase in U. S. twisters. From 1916 to 1950, there was never a year in which as many as 300 were reported; last year, the count was 823. No one is sure whether this is a real increase or merely an increase in the number seen and reported—as population grows in tornado regions.

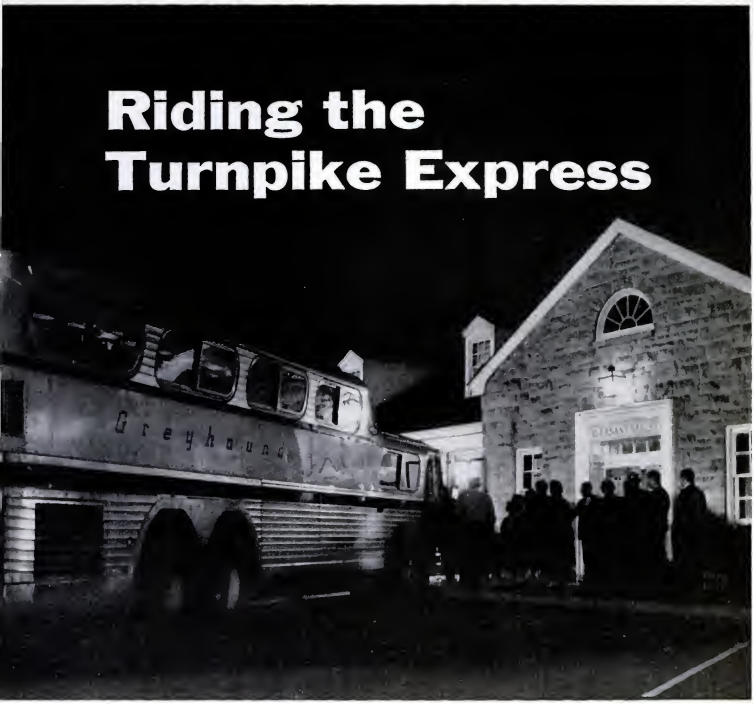
While hurricanes may become less common, fire disasters are on the rise. Losses set a record in 1956, and are currently running slightly higher. There were 430 large-loss fires ($250,000 damage and up) last year, against the previous record of 316 in 1955. John A. Neale, president of the National Fire Protection Association, points to the current urge of industry to build big plants in suburban and rural areas. "Not many small communities," he says, "have the facilities to handle a big industrial fire. This could mean more disasters and more large-loss fires."

There may also be an increase of fire disasters in old people's homes. Everett W. Fowler, Codes and Standards Director of the National Board of Fire Underwriters, points out that they're often substandard from a fire-protection point of view. They seldom earn much revenue, so the owners can't afford much more than old wood-frame houses. They're overcrowded. They lack modern fire devices. The second danger factor is the old folks' inability to move fast enough when fire does break out.

The very young and the old have always been fire's most likely victims. A 1952-1956 survey in Ohio showed that fires

[Continued on page 284]

Riding the Turnpike Express



Night stop—a chance to stretch, enjoy a snack and get acquainted with fellow passengers.

Hop aboard the Scenicruiser for the fastest through bus run in the U.S.—860 miles in 16 hours, 40 minutes

By Harry Walton

FOR something new in bus travel, come along with PS photographer Bill Morris and me on an express trip from New York to Chicago—the longest, fastest through run of its kind in the country. We'll ride linked toll roads across four states, without a traffic light or crossroad in the lot, and see how they wheel the big coaches on a schedule that beats all but the fastest trains.

We got aboard the big Scenicruiser at Greyhound's 50th Street terminal in New York. Bill and I rented pillows for the trip (30 cents each) and took front seats, which I was to regret later.

Driver James M. Tomb fired up the engines and started the air-conditioning. Watching passengers file aboard, I couldn't see how all those waiting could pack into the 43-seat coach. They didn't. A second section was announced for the surplus, and Tomb closed the door. The time: 5:45 p.m.

Buses are stacked in that loading line

A bus trip offers the traveler a chance to sit back and relax

LAST LOOK AT MANHATTAN is this panorama of skyline, glimpsed as the bus climbs a long ramp on emerging from the Lincoln Tunnel.

DRIVER'S VIEW: At his right is the faithful Tachograph.

like sardines in a can. It's no place for butter-fingered steering. But Tomb backed his coach out with the nonchalance of the 24-year, million-mile veteran he is.

As we waited for a light at Ninth Avenue, Tomb announced over the speaker that our first rest stop would be Mechanicsburg, Pa., at 9:46—four hours away.

Minutes later the bus plunged into the white-tiled bore of the Lincoln Tunnel, swept by numerous cars and trucks in the slow lane, and by 5:57 was climbing the long ramp on the Jersey side.

Except for the hiss of the air conditioning, it was quiet aboard. The closed windows shut out traffic noises; from my front seat I hardly heard the twin diesels in back. The big upper-deck windshield gave a fine view of the road ahead.

Traffic sorted itself out among Jersey's many arteries. Tomb headed for the Turnpike, paused at the toll gate, shifted up through gear changes and notched back the diesels to cruising speed.

Letting Bill take my place so he could shoot pictures through the top windshield, I descended the narrow steps and saw that we were rolling faster than it looked from above. The speedometer, housed with a clock in a squarish case, read 60. A bull's-eye glowed redly in one corner.

We closed up on a truck; Tomb checked his rear-view mirror, signaled to pass, and went by. He checked the right-side mirror, signaled again before pulling back to the right.

"They tell me these buses are governor-controlled at 60," I said. "So how come they pass me when *I'm* doing that?"

"***Tail wind,***" he said, grinning. "Sure they're governed, but you may get one set a hair over the limit. Given a light load or a downgrade, it might roll six or seven miles faster." He paused to pass a trailer truck. "Doesn't pay us to speed, though—got to pay our own tickets. We don't get blamed for running late. But the driver who arrives early, or makes up too much lost time, gets called on the carpet."

A car in the left lane forced Tomb to cut speed. He sounded the horn; the car stayed there. "One thing I won't do is pass on the right," he said. Eventually the car pulled over.

At Interchange No. 6 Tomb turned off onto the connecting link between the New Jersey and Pennsylvania Turnpikes. We made the toll stop, crossed the high-flung Delaware River Bridge, and rolled into the Keystone State. At dusk we passed historic Valley Forge. Tomb held the big coach right at 60. Night fell. At one point the glare of steel furnaces painted the sky. Some passengers dozed. One

It records speed and time, flashes its red light at 60.

CLEANING TOP-DECK WINDSHIELDS during the run isn't usually part of the service. We had it done to make sure we'd get good photos.

of them held a portable radio to his ear.

We arrived early at the Mechanicsburg stop, chiefly because, being full up, we'd skipped a second loading stop in New York. "You get the extra time here," said Tomb. "Thirty minutes instead of 15."

Almost everybody got off to stretch or get a snack at the restaurant. Bill shot some night pictures while Tomb checked in with his relief driver, W. R. Kolbe.

Kolbe counted noses as passengers got aboard the bus again. (Wayward passengers are sometimes left behind at city stops, but rarely on turnpikes.) With everybody accounted for, he swung back onto the road.

The Pennsy Pike bores through the Appalachians via tunnels bearing such fascinating names as Tuscarora Mountain and Sideling Hill. At the latter, traffic was single-laned because the tunnel was being washed down. Roof lights flashed past in rapid-fire sequence, a hose splashed the bus briefly, and we emerged past a string of waiting Fruehaufs and a forlorn autoist changing a tire.

I reflected comfortably that any tires changed this trip would be no worry of

When you go by bus . . .

- Wear comfortable shoes—the casual slip-on kind if you have them.
- Take a thermos bottle to soothe thirsty children between stops. Remember to fill it at restaurants; water in the bus washroom isn't for drinking.
- Front seats are fine for kibitzing the driver, but check their leg space and footrests beforehand if you intend to stretch out and nap.
- Rent a pillow. It supplements the headrest, increases your chances of sleeping comfortably.
- Watch your step on the stairway of double-deck buses. Grip the handrail. Don't stand, or let children stand, near the steps. A sudden application of the brake could throw you down them.
- Plan on the big meal of the day before you get on, or after your arrival. Meal stops are fine for snacks but too short for a full-course dinner.
- Think about taking a sleep mask if you find it hard to doze by daylight. You may want to sleep while the sun shines.
- Check heavy luggage through. Pack shaving and other toilet articles, reading matter, toys and games for the tots, and other trip incidentals in a bag small enough to keep near you in the seat rack.

Through the king-size windows of the mile-a-minute two-deckers,

ROLLING THROUGH APPALACHIANS, you ride through seven tunnels on Pennsy Pike. But dips into darkness are followed by scenes like this.

GOOD SAMARITAN of the highway is the courtesy car,

mine (they weigh 300 pounds apiece). The coach lights were off now. Though there are individually controlled spotlights for stay-awake readers, most passengers seemed to be asleep.

Truckers waved us past by dimming their lights. A timid motorist crawled up from behind, hung back in the left lane, his headlights glaring in the rear-view mirror, then inched by. Hardly 10 feet ahead he began to pull back into the right lane. Kolbe had to touch the air brakes; our speed dropped to 55.

"We don't care how many go by us," he told me wryly, "so long as they keep going. This guy I may have to pass again."

But as if emboldened by his success, the driver sped up and disappeared. The 60-mile signal flashed on again. Our headlights swallowed up mile after mile as Kolbe steered around the turns with enviable precision.

"How do you drivers fight highway fatigue on these turnpike runs?" I asked.

"First of all by getting enough sleep," he said. "That's a rule. My own dodge is not to stare ahead all the time. I glance from side to side just enough to break the monotony."

The pike's gentle grades slowed trucks down, but we swept by as Kolbe touched a button on the stick. This down-shifts a two-speed planetary gear, giving a lower third-gear ratio. The change is as smooth as the kickdown with overdrive or an automatic box.

A buzzer sounded, but Kolbe ignored it. Soon a young fellow emerged sheepishly from the washroom. "I always give them one buzz to be sure," said Kolbe, explaining that many passengers mistake the plainly marked emergency button inside for a flush control.

You get all kinds of passengers, Kolbe reported. Westbound trips like this one often carry European visitors. (I found later that on board were an English family of five, just off the boat and en route to California; a Danish couple here to see relatives in Oregon, two English tourists, and an elderly Dutch couple going to visit their son in Calgary.) At the beginning and end of school terms, students and teachers travel by the thousands.

"We carry more women than men," a terminal official had told me. "They have more leisure time to travel, and they like to ride a bus." A Los Angeles woman on our trip said she had visited relatives in New York once a year for nine years—always by bus.

Our second stop was at 12:59; the place, a restaurant, still on the Pennsy Pike. A few sleeping children stayed on board. Wondering whether the luggage

whose driver helps motorists besides keeping tab on buses.

ENTERING CHICAGO, passengers take in the big-city skyline. Flat area just ahead of the windshield is the roof of lower bus deck.

in our seat racks was safe, I was told there is little trouble with theft.

We had soft drinks, stretched our legs, and 15 minutes later were herded aboard again. Trying to sleep in my upper-deck seat, I found the gentle, random rocking of the coach on its air springs more restful than the click of railroad wheels. But leg room in that front seat was too short. Eventually I squirmed into a barely tolerable position and dozed.

The loudspeaker woke me as Kolbe announced a 15-minute stop. (Most people, the company thinks, want stops announced even in the early-morning hours.) It was four a.m. We were on the Ohio turnpike, 500 miles from New York. Two thirds of us got off, groggily. Even now the restaurant, at the Great Lakes service plaza south of Cleveland, was crowded with hard-driving autoists.

Our third driver, T. W. Moore, had the longest run of the three—344 miles into Chicago. Drivers are paid on a mileage basis—about nine cents a mile, plus pay for ferrying a bus to or from its division garage. Turnpike runs may swell a driver's pay to $600 a month.

Conning Bill Morris into a swap of seats, I got more leg room and fell sound asleep until Moore announced our breakfast stop. It was 6:33 New York time. We tumbled out at Oak Opening service plaza and yawned ourselves awake.

With only 30 minutes to eat, few men passengers elected to shave in the restaurant washroom. (The one on the bus has no hot water for lather shaving, but does sport a 110-volt shaver socket.)

Bill and I settled for eggs and coffee. The English children, chattering like characters in a Late Show film, joyously discovered flapjacks. I set my watch back an hour to Central time.

After Moore had rounded us up and

[Continued on page 285]

More turnpike express runs are coming

As THE Federal highway program opens more super-roads, express-bus nets will spread. A Greyhound through run links Kansas City and Abilene, Tex., over two turnpikes. Trailways matches train time, Los Angeles-San Francisco, and has extra-fare luxury service: hostesses, German-built coaches, free snacks, music. You can take such other through trips, too, as Kansas City-Oklahoma City, San Diego-El Paso, Dallas-Shreveport, Memphis-Birmingham. And there's a coast-to-coast through run, New York-Los Angeles.

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How Your Youngster Can Choose Both a Job and School

Industry is filling an urgent need for trained employees by financing their education—with full pay, on company time

By Vance Packard

YOUR youngster needs advanced, specialized training to get ahead these days. But maybe he has to go to work and support himself. Did you know that he can do both at the same time?

I uncovered this astounding fact during recent weeks while consulting many dozen companies. I found that firms all across America are paying young men and women good wages *while educating them at company expense.* They are spending tens of millions of dollars each year just to send employees to school, to learn to be everything from salesmen to doctors of philosophy.

This is simply good business. American industry needs more skills and brainpower than it can find ready-to-use. So hundreds of firms have gone into education on a large scale. A few have even set up their own campuses with fully accredited, degree-granting colleges.

Promising young men and women are now *invited* by some companies to come onto the payroll with the specific understanding that they will receive higher education at little or no expense to them. One such firm is the giant General Electric Co. Let's see how its "engineering apprentice" program works.

Suppose your son is accepted as an engineering apprentice at GE's great transformer plant in Pittsfield, Mass. He will go onto the payroll right away, full-time. Also right away, he and about 30 other young men will start a training program that will last four years. He will rotate work assignments in the machine shop, drafting room and engineering office. In addition, for nine hours each week—evenings and Saturday mornings—he will attend classes taught by instructors from the University of Massachusetts. Here are the courses:

First year: chemistry, math, English, inorganic chemistry, analytic geometry, public speaking.

Second year: calculus, physics, English.

Third year: physics, European history, advanced calculus, electrical engineering.

Fourth year: statics, electrical engineering, DC machinery, economics.

At the end of the four-year program he will be graduated as an engineering technician with two years of college credit. And he will have gotten a raise in pay about every six months. If he wants to go on to earn his degree as an engineer, the company will still underwrite him. It will pay all costs for night classes at nearby colleges. The company may even give him time off with pay—as much as four hours a week—to study.

How much money is spent on him? In effect, the company assumes virtually the entire cost of an engineering degree. If the student-employee wishes to speed up

Some companies operate their own schools to teach

his education by studying full-time, the company may lend him up to $1,000 . . . give him a leave of absence . . . and perhaps grant him a scholarship. And if he wants to study beyond his bachelor's degree (for his master's or doctor's degree) the company may offer a leave of absence plus a living allowance of $1,750 to $3,500 a year!

GE also runs similar programs to develop draftsmen, toolmakers, electricians, and, at the college level, engineers. To join one of these groups, a candidate must have finished high school in the upper half of the class. His record should show he has a knack for math and science. Finally, the most promising applicants take a 3½-hour test.

Such care in preselection for training pays off later for those who make it. GE boasts that more than half the graduates of its various apprentice programs have gone up the ladder to management positions: supervisors, managers, engineers, even vice presidents.

(For further information about GE programs, write the Apprentice Training Director of the plant nearest your home. Some of the larger ones are at Bridgeport, Conn.; Erie, Pa.; Evendale, Ohio; Fitchburg, Mass.; Fort Wayne, Ind.; Holland, Mich.; Philadelphia, Pa.; Rome, Ga.; Schenectady, N. Y.; Somersworth, N. H.; Syracuse, N. Y.; Waynesboro, Va.; and West Lynn, Mass.)

That's how one big corporation helps employees gain an education. What about others? Many different ideas are being tried out. In shopping around among them, it helps to know that most of the plans fall into one of these four categories:

1 *Study on company time, at company expense, in company classrooms*

You will find that most sizable companies today have large-scale job-training programs of this type. The manual of courses offered to employees of the Standard Oil Company of New Jersey is as thick as a mail-order catalogue. Some examples: a month-long course for industrial salesmen, another for refinery operators, another shorter course on "basics of supervision." Chrysler Corp. offers full-time courses (on company time) in 11 skilled trades: toolmaking, die-making, machine repair, die sinking, body-fixture building, electrical maintenance, pipefitting, tinsmithing, millwright work, die-model building, sheet-metal "experimental." The Metropolitan Life Insurance Co. will arrange, partly on company time, for one of its employees to become a professional actuary.

The most exciting on-the-job schooling I encountered is that conducted by General Dynamics, which makes atomic submarines, guided missiles and supersonic bombers. It has developed a vast program of instruction for the reason that many of its subjects are so out-of-this-world that most colleges don't yet teach them!

At the atomic-sub plant in Groton, Conn., for example, the company developed a course in "elementary nuclear physics" to help employees understand what they were doing. The company-prepared textbook has since been adopted by many U.S. schools. Seminars on astronautics are held for employees at the missile plant in San Diego. Students learn about missile-control systems, space propellants—and even about problems of space flight itself.

As one official remarked to me: "These are things most universities haven't even dreamed of giving."

At its Fort Worth plant, General Dynamics is spending hundreds of thousands of dollars teaching employees everything from blueprint reading to new concepts of aerodynamics. For many of its courses it brings faculty members from Southern Methodist University right into the plant

Where to Find Out About Company-Paid Education

JUST helping your youngster get a job with a big corporation doesn't guarantee him a free education, of course. The kinds and amounts of school help vary from company to company. For detailed information on individual programs:

- Ask your high school's guidance counselor about activities of local firms.
- Find out what your own company is doing to further the schooling of employees and employees' children. You may be surprised.
- Write to the director of public relations

subjects so new that colleges don't yet offer them

—employees on the job can thus even earn university credit.

2 Study in spare time at company expense

Here you get the programs that put the emphasis on "education" more than "training." You'll find that many companies urge promising employees to study at night, at company expense, subjects not directly related to the job. They even offer testimonial dinners, cash bonuses, extra vacations and raises to employees who win scholastic honors. Some will rearrange work schedules to give the employee-student a better chance to study.

A few companies operate their own free evening schools for employees. Perhaps the most famous is the Chrysler Institute of Engineering in Detroit. Every Chrysler employee is welcome to attend classes, free. Those who do go mean business: Classes run from 6:30 to 9:30, Monday through Thursday. This institute is authorized to grant regular college diplomas in mechanical engineering. Credits earned are accepted by any engineering college in the U.S.

The institute also offers shorter technology curriculums, covering 25 semester hours of standard college work, which qualify employees as "technicians." Certificates are awarded in general technology, chemistry, metallurgy, plastics and rubber, electricity, mechanics, mechanical drafting, and body drafting and design.

Another company that runs its own evening schools is the Crown Zellerbach Paper Co. in Camas, Wash. It has 12 faculty members, any employee can attend, and books and tuition are free.

The trend today, however, is toward underwriting the night courses that employees take at a nearby college or from a correspondence school. (More than 5,000 companies have formal arrangements with one correspondence school alone.) These underwriting programs go by various names: off-the-job education, employee study plan, self-improvement program. Most commonly they are called "tuition-aid plans."

New York University surveyed its night students and found that employees of 82 companies were having their tuition paid by their companies! RCA is spending upward of $170,000 a year to reimburse employees for completing college courses. The Southwestern Bell Telephone Co., which will contribute a maximum of $300 a year, reports that 1,800 of its employees are taking advantage of the plan to study math, business administration, public speaking, engineering and economics. An official of Standard Oil told me proudly that one of his employees had earned his B.A., M.A. and Ph.D. with company money.

Every company has its own regulations concerning these aid plans, but in general they work like this:

How much of the bill? Dozens of companies (such as RCA and the Chase Manhattan Bank) pay all tuition costs. Others pay a fraction. Some base the pay-off on grades. One leading firm pays 100 percent if the student-employee gets an A, 75 percent if he gets a B, 50 percent if he gets a C, and nothing if he gets less than C. While some firms help only with tuition, others cover all schooling costs, including supper money, textbooks, lab fees, even baby sitters. Socony Mobil pays half the tab for the diploma itself.

What can be studied? Most companies want your youngster's courses to benefit both him and the company. Esso puts it this way: The course "must have some bearing on the employee's performance of either his present job or a position to which he is likely to be assigned in the future." But an official told me, "In practice, we are very, very generous." Some

[Continued on page 286]

of any company you are interested in. Ask for leaflets the company has prepared on its educational policies. (If you can't find the address in the phone book, check the industrial directories in your public library.)

- Check with your friends about the aid-for-education plans being offered by companies they work for.
- Consult reference books such as *You Can Win a Scholarship* ($2.98, Barron's Educational Series, 343 Great Neck Rd., Great Neck, N. Y.), which includes a section on company-sponsored scholarships.
- Inquire at colleges that sound good to you and your youngster about industrial scholarships or co-op plans there.

Million-Dollar Drive-In Offers Films, Fun and Food

SPRAWLED over 28 acres in Copiague, New York, the 2,500-car All-Weather Drive-In Theater is one of the country's biggest. But aside from its magnitude, this suburban movie mecca offers its patrons many unusual features: an amusement park and playground for the kids; a cafeteria where you can fill up on hot dogs, pizzas or a real meal; an air-conditioned indoor theater for rainy evenings; even a trackless train to transport the cash customers from one attraction to another. Fun starts at one p.m.

The All-Weather Theater reflects the phenomenal growth of outdoor movies since World War II. In 1946 there were 300; now there are 6,000 catering to a weekly audience of 35,000,000. Drive-in operators attribute it to the mass move to Suburbia, more autos, and a shortage of baby sitters.

PS PHOTOS BY W. W. MORRIS

SKY-TOP RESTAURANT on roof of indoor theater (left) serves full dinners. The family above enjoys a snack on the patio outside the cafeteria. Both spots offer an unobstructed view of the movie screen.

ADMISSIONS GATE, like a highway toll booth, automatically registers each car as it passes through. Figures on "tote board" indicate the number of paying customers in each auto.

CAR SPEAKER with individually adjustable controls appeals strongly to a trio of tune-it-yourselfers. Wide range in volume of the speakers is a special boon to the hard-of-hearing.

TALLY-HO TRAIN provides quick transport from parking lot to movies and all other areas. During the 18-minute break between pictures, kids hop aboard for a free ride to the playground.

RAINY OR CHILLY EVENINGS? It's business as usual at the All-Weather Drive-In. The indoor theater (above) seats 1,200. This theater is open in good weather, too, for patrons who prefer to watch the movie in air-conditioned comfort. Films are presented simultaneously on both indoor and outdoor screens. The cafeteria is connected directly to the indoor theater.

NO BABY SITTERS need apply. These pajama-clad noisemakers have given up at last and gone to bed contentedly in the back seat, leaving Mom and Dad free to enjoy the picture in peace. END

Army's New Machine Gun Shoots from

YOU have seen the GI movie hero stalk boldly into battle firing a Browning machine gun from the hip—or even shoulder. That's Hollywood, and gets a laugh from any former service man who has ever lugged a machine gun around.

Now, however, the Army can really shoot from the shoulder, not with the Browning, but with a new lightweight weapon that has lopped from 10 to 20 pounds off the three .30-cal. machine guns it was developed to replace.

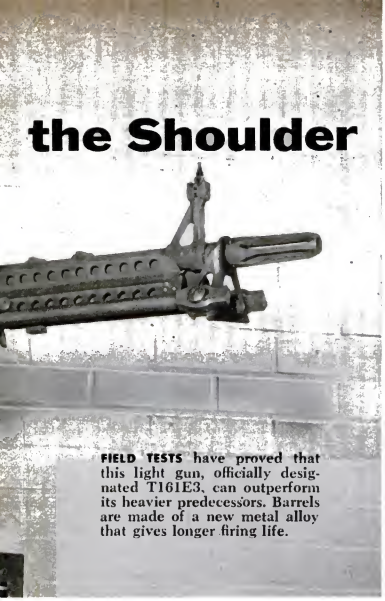
It is the "Caliber 7.62-mm.," a 23-pound, air-cooled, general-purpose machine gun. Its rate of fire (600 rounds a minute) is about the same as the heavier guns now in use, so that infantry gunners will still be able to get off short bursts.

This was an achievement: holding down the rate of fire while cutting gun weight almost in half. Hitherto, Ordnance

Heavyweight ancestors pose with the new one-man machine gun

Maxim of 1904 weighs 140 pounds; 1914 Hotchkiss (center), 110 pounds; new gun, 23.

the Shoulder



FIELD TESTS have proved that this light gun, officially designated T161E3, can outperform its heavier predecessors. Barrels are made of a new metal alloy that gives longer firing life.

experts at Aberdeen Proving Ground explain, light weight in experimental machine guns has been obtained by using a light recoil mechanism, which demands a high rate of fire. (A low rate of fire requires heavy recoil parts, defeating the purpose.) But with higher rates of fire, barrel whip impairs accuracy.

Weight reduction and low rate of fire were accomplished in the new gun by designing a new, lightweight gas-operating mechanism. In this system gas is bled from the barrel into a cylinder to operate a piston that works the firing mechanism. A hot barrel can be replaced in a few seconds.

Recoil is less in the new gun. This is done by a spring-loaded buffer assembly in the butt that distributes the recoil over a greater period of time.

Another new feature is indicated in the weapon's designation: Caliber 7.62-mm. It refers to the ammunition, which is the NATO (North Atlantic Treaty Organization) 7.62-mm. cartridge. It is half an inch shorter than the standard U. S. .30-caliber cartridge.

FOR HIP SHOOTING, the gun is designed so that the gunner doesn't grip a hot barrel. It also can be fired from a tripod mount (not shown).

REPLACING THE BARREL takes mere seconds. Feed-mechanism cover is raised and the barrel is unlocked by pulling back the bolt, as above.

UNLOCKED BARREL pulls out. When removing a hot barrel under actual firing conditions, the machine gunner would wear special gloves.

A CARTRIDGE, used as a punch or lever, is the only tool needed to field-strip the weapon. Time for this: less than 10 minutes. END

The Most Difficult Rescue in Mining History

Trapped for 10 days almost half a mile beneath the earth's surface, two European miners survived a soul-searing ordeal

By J. D. Ratcliff

A FEW minutes before one p.m. on November 28, 1956, Günter Effenberger and Herbert Spiess walked aboard the crowded pit hoist of the Fröhliche-Morgensonne coal mine at Wattenscheid, seven miles from Essen in Germany's Ruhr Valley. They were totally unaware that they were about to become potentially legendary figures in mining—as subjects of the longest, most dramatic, and most technically difficult rescue in modern mining history.

Like a plummet, the hoist dropped into the inky blackness of the shaft, then stopped at Level 7. The two men got off, walked half a mile through the mine to another hoist, a 585-foot shaft connecting Levels 7 and 8. Here, they dropped down another 150 feet to the Waterfall seam, a working abandoned 20 years earlier but now being reopened. At this point they were nearly half a mile—2,200 feet to be exact—below the surface of the earth.

Until shortly after seven p.m. the day was like any other. The men cut coal from the seam with pneumatic drills of the type used in street-repair work, loaded it into cars. At five o'clock they had a snack meal of sandwiches and tea. A few minutes after seven o'clock they pushed two loaded cars aboard the hoist and then walked back to the face of the coal to resume work, a distance of 260 feet from the shaft.

They had barely taken up their positions when there was a deep, ominous, earth-shaking rumble. A rush of air followed, kicking up coal dust as it went. Then the drill went dead—the compressed-air pipeline had been broken.

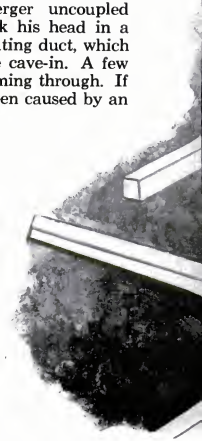
In under a minute the two men were back at the shaft and saw what had happened. The entire shaft had caved in. Their only exit was blocked by hundreds of tons of rock—a mighty coffin lid sealing a tomb that might never be opened.

Effenberger, a friendly, smiling man of generally optimistic outlook, had been a miner long enough—nine of his 27 years—to know that life might depend on quick, clear thinking. Spiess, 38, was less experienced.

"We may be here a long time," said Effenberger. "If we want to stay alive we better get going."

Water and air were the first problems. Mine water was undrinkable, but there should still be water in the pipe used for wetting down the drill. Fearful that it would siphon off through a break in the collapsed shaft, Effenberger uncoupled the pipe. Then he stuck his head in a broken end of the ventilating duct, which had been severed by the cave-in. A few wisps of air were still coming through. If the shaft collapse had been caused by an

CHART at right shows the layout of the mine at Wattenscheid in Germany's Ruhr Valley, where Effenberger and Spiess were entombed during the longest rescue in mining history. They were trapped in the Waterfall seam, 2,200 feet below ground. Experienced mine-rescue men gave them little chance to come out alive. Finally, when rescue was minutes away, new tragedy struck which threatened to doom the effort.



LEVEL 7

RESCUE SHAFT

CAVE-IN

WATERFALL SEAM

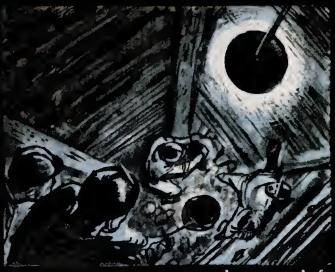
OLD MAN SEAM

FIRST BORING

SECOND BORING

LEVEL 8

ACCESS TO LEVEL 8
THROUGH ANOTHER SHAFT



TO PREVENT FURTHER CAVE-IN, the rescue shaft was boxed with heavy timbering. Big stones were broken up, loaded in iron buckets and passed up the shaft to men clinging precariously above.

ON THE SIXTH DAY, at three a.m., there was a crunching sound on the floor of their dank prison. Effenberger switched on his lamp. At their feet was the slowly rotating head of the drill!

CHEWING ITS WAY UPWARD through hard rock, the drill would have to traverse an abandoned gallery. Going through this empty space, would it deflect and never hit the small target area?

explosion, poisonous gases might soon become a threat—in which case the air duct might be a lifesaver. Effenberger and Spiess pulled together the broken ends of the rubber duct and wired them.

Batteries of their electric lamps were charged to give 14 hours of light. Seven of those had been used up. "We can get along without light," they decided. "From now on, we'll use it only when necessary." Lights were switched off and the two men sat down in the darkness to wait.

"***They'll try to get us out,***" said Effenberger. But they both knew enough of the layout of the mine to realize that they were deeply trapped. They were in one of the worst possible spots for rescue.

Word of the cave-in was spreading rapidly through other sections of the mine. The hoistmen who had taken on the two loaded cars experienced an almost miraculous escape. They had stepped out of the shaft only seconds before its collapse. Miners and foremen sized up the extent of the disaster. They guessed correctly that the trapped men were probably working at the face of the coal when the cave-in occurred. Therefore they should be safe —at least for the moment.

A telephone call was put through to Dr. Wilhelm Mieles. He is managing director of the mine company, a division of the Rheinische Stahlwerke, one of the Ruhr's great combines of coal, iron and steel.

Mieles, 46, is a big, powerfully built, jut-jawed man. He comes from a family that has been in mining for nearly 200 years. It was 10:30 at night when he received the call, in a restaurant where he was entertaining a group of 20 mine doctors. He excused himself, hailed a passing motorist and asked to be taken to the pit head. There he donned mine clothes, rubber boots, a leather helmet—an outfit he was to wear for the next 55 hours. He started underground immediately.

At the time Mieles was receiving the telephone call in the restaurant, Ruth Spiess, wife of one of the trapped men, was sitting in the parlor of their apartment in the mine village, waiting for her husband to come home from the shift which she knew ended at eight o'clock. All miners' wives worry when their husbands are late from work, and Spiess was now an hour and a half overdue. She tried to solace herself with the thought that he might be working an extra shift—Christmas was near and, with three children, extra money would be needed.

Still, this seemed unlikely. The mine management didn't permit extra shifts unless there was emergency repair work to be done. When her worries became too much for her, she sought out her brother-in-law, Erich Scheinhard, also a miner, who lived nearby. Scheinhard knew of no accident, readily accepted the extra-shift suggestion. Why didn't Ruth go home and get some sleep? The night shift would be coming out at five a.m.

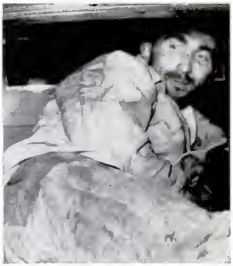
Immediately on going underground, Mieles examined the bottom of the caved-in shaft at Level 8. Then he went up to Level 7 to look at the top. Because of failure of the ventilating system in this portion of the mine, a thick, humid fog enveloped everything. It was impossible to peer down the shaft to judge the extent of the cave-in, to see how much shaft was left intact.

There was only one way to find out—to go down and see, at imminent risk of being buried alive by another collapse. It took until shortly after midnight to rig a steel bucket and winch. Mieles might have delegated someone else to the job. "But a manager has a moral responsibility," he says. So he climbed into the bucket.

Occasional rocks were still falling and echoing hollowly from the darkness below as Mieles was lowered away. At 130 feet he hit the top of the cave-in. Mieles shouted. If the trapped men answered it would indicate that their predicament wasn't too bad. But there was no reply. A quick survey indicated that rescue from this direction would be exceedingly difficult, maybe impossible.

Mieles set up headquarters for the rescue effort in the pit-head mine office. Draftsmen were routed out of bed and set to work making blown-up blueprints of the trap area. Professional mine-rescue teams were summoned to advise. Possible rescue tunnels were sketched on mine maps, and time to dig them calculated. One would take 75 days, another 30—both impossibly long unless the object was to recover

thing was to be alive"



BEARDED AND HAGGARD after their rescue, Herbert Spiess (near photo) and Günter Effenberger are brought back to the surface —and life. They had been buried alive for 238 hours. For days the two men subsisted on tea and water, made up games of checkers, fought numbness, sent signals, listened, prayed.

bodies for a funeral. Mieles wouldn't settle for this. "We are going to get them out," he said, "and we are going to get them out alive."

Drilling looked like the best answer. If you could drive a big enough hole into the trap area the men could at least be fed by this route while more elaborate rescue plans were devised. Such a rescue scheme had been used successfully on previous occasions. But in none of them was the distance as great as in the present one.

Although the trapped men were down a vertical distance of only 150 feet in the collapsed shaft, a much greater distance would have to be traversed by drill hole, since there was no entry directly above them. Drilling downward presented another problem. Enormous quantities of water would be needed to flush the drill hole. How to dispose of it?

All considered, the best approach appeared to be from below. Because of the sharp-angle pitch of the coal seams, the distance to be traversed from Level 8 was 351 feet.

In their dark prison Spiess and Effenberger tried to sleep, but sleep refused to come. Occasionally a lamp would be switched on to check the snail-like march of hours. On the wall of the mine, Effenberger chalked a rough calendar, so they could keep track of the passing days.

Spiess had a little tea left. They drank that. How long could they last without food? Effenberger *knew* he could last seven days—he had gone that long as a prisoner of the Czechs during the war.

To lighten the sleepless hours they devised a checker-like game, sketching a playing board on a plank and using lumps of coal as checkers. A meager amount of precious light was rationed for the game. But neither man was really interested.

When her husband hadn't arrived home by 5:30 a.m., Ruth Spiess started for the mine. There were a number of miners on the street, coming off shift. Yes, they said, there had been an accident. She went on to the mine office. There they tried to console her, persuaded her to go home and wait.

Most of the second day, November 29, was spent by the rescue team, now grown to 100 men, in dismantling and moving a five-ton drill into position on Level 8, below the trapped men. It had to be cemented into place with quick-setting concrete. The direction the bit was to take had been charted, but on its upward journey, chewing its way through hard rock, the drill would have to traverse an abandoned gallery—the Old Man seam. Going through empty space, would the drill deflect and never hit the small target area? The entry where the men were trapped was only nine feet wide. The answer wouldn't come for many hours.

At two a.m. on the third day, the drill, powered by compressed air, began to turn. By now Mieles was blank-faced with fatigue. Grimy, wet, he tackled another problem. If the drill got through, the men could be supplied and kept alive through the 5½-inch hole, but they would have to be gotten out the usual way, through a tunnel. At seven a.m., work started on a rescue shaft to be built around the cave-in area of the shaft Mieles had explored in the bucket. But first, the old shaft would have to be retimbered to make it safe. Bossing this dangerous job fell to 59-year-old Fritz Tiedemann, who had worked in

[Continued on page 288]

Your New Car's First Trip

EVERY working day of the year, 20,000 U. S. truck drivers hit the road with cargoes of automobiles. Their semitrailers tote from three to five cars apiece. Most of the cars are brand-new, on their way from factory to dealer. A single load can be worth $20,000—and up. The cars ride in and on a big, open-sided contraption that looks like a bridge on a hunt for a river.

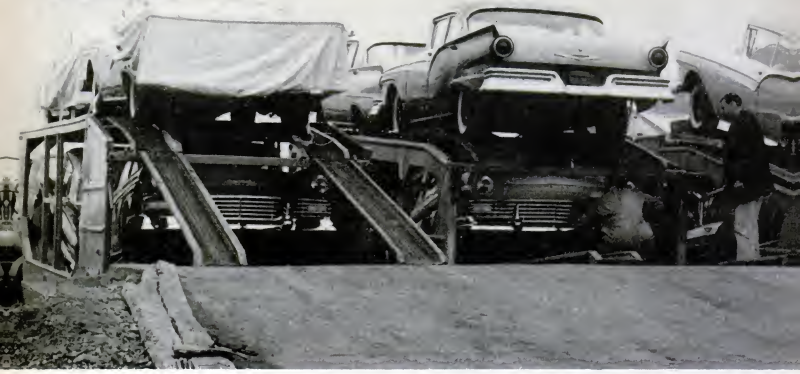
One of the most expert drivers of these "haulaways"—monsters weighing from 33,000 to 35,000 pounds—is Tom Broecker. He has driven 2,000,000 miles, and has delivered 20,000 cars, without an accident.

Tom has been at it for 24 years. He knows that a loose tarpaulin can rub ugly spot-glosses on a finish. He knows that if the snubbing chains are too tight, they can bend the roofs of the pillarless hardtops. He knows that fresh surfacing on a road may reduce the meager clearance for his rig at the next underpass.

Come along as Tom Broecker tells you in his own words about your car's first trip.—*Devon Francis.*

"I haul Fords from the factory in Dearborn, Mich. The first thing I've got to do is find my cars in the storage yard. They're tagged for destination. On this trip I'll have a split drop—one of the cars will go to Buffalo, two to two dealers in the Rochester area, one to Syracuse. The cars are convertible hardtops—the kind that really convert."

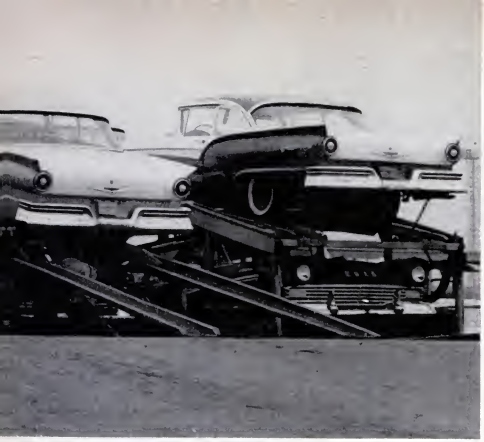
"I drive each car aboard myself. They have been 'shaken down' by Plant Protection to see that nothing extra is taken out of the yard. Wheel disks and floor mats are locked in the trunks to prevent theft. I have to get the cigarette lighters—the most easily stolen item—from a yard office. The cars on the bottom of the rig ride pitched—that lowers their roofs and keeps the overall height within the legal limit of 13½ feet."



"The ramps on top are hinged to allow loading below. Tarps cover the top cars only if

"The idea is to deliver the payload. Even when bad roads or weather hold me up, I still take plenty

"My rig, one of several hundred operated from Dearborn by the E & L Transport Co., is out-gated by a yard guard. With the 'horse,' or tractor, it weighs around 33,000 pounds. It's 45 feet long and eight wide. I've got 1,324 square inches of brake surface to stop with—more than five times as much as a passenger car. On the other hand my tractor engine, at 158 horsepower, needs a two-speed axle to get over the humps. With my four-speed box, I can get a reduction of 67:1 at my driving wheels. That costs gas, of course. I only get five to six miles to the gallon out of the 172 gallons I carry, less in headwinds. That's an estimate—my cab doesn't have a gas gauge."



there is danger from tree drippings, blowing sand, snow."

"I snug the cars down with toggle clamps. These have to be just so tight and no tighter. I recheck the load a little later on the road."

of time"

"The two-lane roads are bad—worse if they're covered with oil and rain—and the biggest hazard is the guy who makes a habit of cutting in and out. It used to be that I would signal with my lights to a car behind that it was safe to pass. But some drivers wouldn't understand, or would hesitate, and there could be an accident. My company has discouraged this practice for some time now."

"I never know when I'll be stopped by an inspector, from the Interstate Commerce Commission or Markel Service, a safety-engineering and insurance company. My log entries must not be more than two hours old. The ICC can fine me for falsifying my log or not keeping it up to date. I'm allowed 70 on-duty hours each eight days. Then I'm 'hot' until rested up. Company rules say I'm not to drive over 45 miles an hour. I don't—I have to pay my own speeding tickets."

"The top cars come first, on long skids. You

"Underpasses are a headache if the route is new to you. In case of doubt about clearance, you climb to the top of your rig and take a sighting. At times, I've had to unload the top deck to get through."

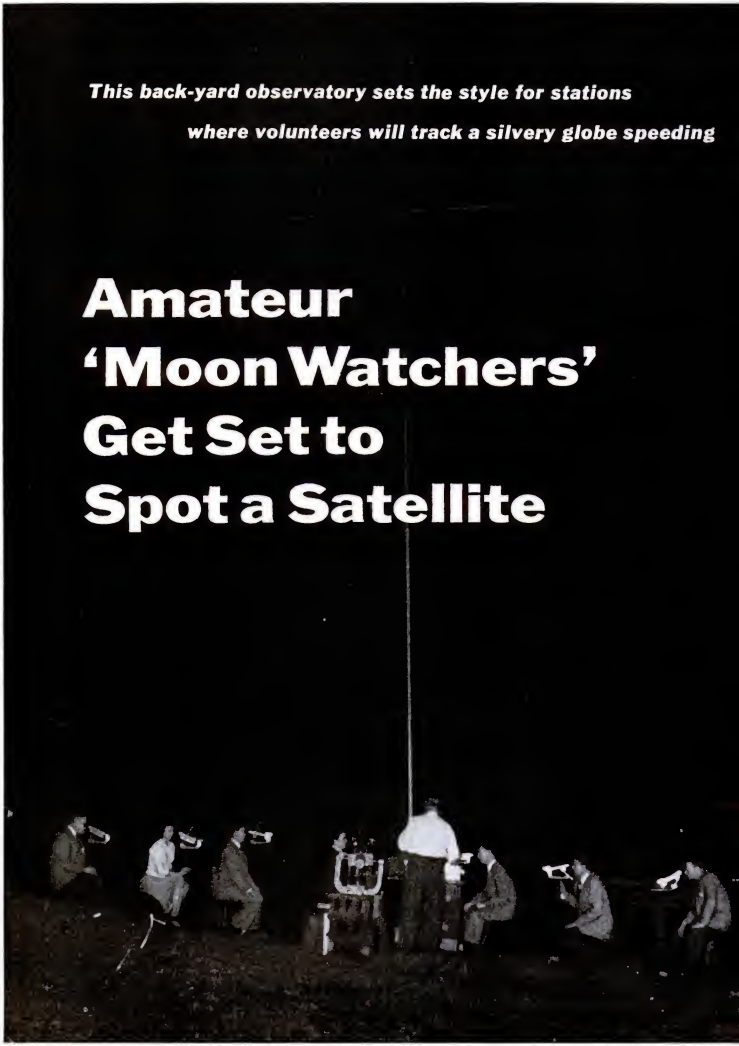
"It's dusk at my Syracuse drop. I've put in

have to brake carefully. It's hard work, but it pays well—I earn about $8,000 a year."

my 10 hours in one day under the ICC rules. Tomorrow I'll deadhead home." END

This back-yard observatory sets the style for stations where volunteers will track a silvery globe speeding

Amateur 'Moon Watchers' Get Set to Spot a Satellite



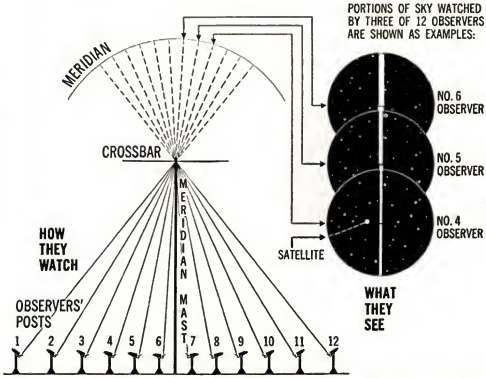
through space

SATELLITE SPOTTED! Simulating a sighting, observer Bob McCracken presses button below 'scope to register the time on a sound tape.

By Alden P. Armagnac

AMATEURS expect to be the first to see a man-made moon—and the last, before it plunges to a fiery end. At this writing, 1,400 of them have readied 84 "Project Moonwatch" observing stations, to help track the half-dozen earth satellites that the U. S. will attempt to launch before the end of 1958.

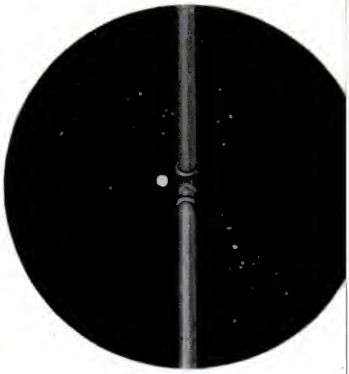
How they'll spot a satellite may be seen at the Moonwatch station set up by G. R. (Bob) Wright of Silver



"MOONWATCH" OBSERVERS of Wright's team man their posts at his Silver Spring, Md., station (left). Through 'scopes trained on top of mast, they watch long strip of sky (diagram). Wherever a "moon" crosses the strip, at least one observer should see it.

Lucky observer's reward will be this exciting spectacle as earth

"I GOT IT!" may be watcher's jubilant cry at first sight. Grammar isn't important; pushing timing button is.



"OUT!" he says, and taps button, as fast-moving satellite reaches the mast and vanishes behind it momentarily.

Spring, Md. A Weather Bureau expert by profession and an amateur astronomer by hobby, he heads the National Advisory Committee for Visual Satellite Observations. At his pioneer station, the country's first, he and his team have been trying out the instruments and procedure to be recommended to other groups.

What they'll all be looking for is a faint, moving pinpoint of light in the twilight sky—actually a silvery 20-inch globe, circling the earth 12 to 14 times daily at an altitude of 200 to 1,500 miles. It can be seen when it passes over an observer's area soon after sunset, or shortly before sunrise. At best it will be no brighter than a sixth-magnitude star, barely visible to the naked eye. It can be distinguished from the stars because it will be sailing rapidly across the sky, from west to east, seemingly about as fast as a high-flying airplane.

PLAYBACK of tape recording will yield data that Bob Wright (center), leader of Silver Spring group, will telephone to Cambridge to help scientists chart the path of an earth satellite.

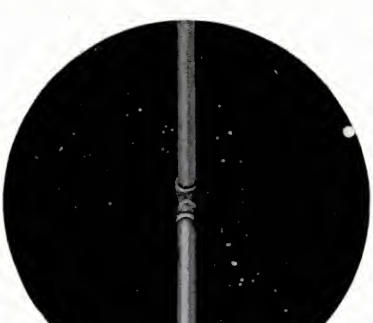
Real first-class satellite watching isn't for a "lone wolf," Bob Wright explains. You might sit watching for the "moon" with the best of binoculars and never see it, if you weren't looking in just the right direction at the right moment.

What it takes to spot a newly launched satellite is an organized team, preferably a dozen members or more, each observer standing guard over a sector of sky assigned to him. Center of their activities is an outdoor observatory, patterned after the one Wright shows you in his backyard.

First thing you see there is a metal pole, topped by a crossbar, standing 30 feet high. Exactly north and south from this "meridian mast" extends a 52-foot-

satellite sails across field of view. Here's what he does about it:

"IN!" Button signals reappearance. Especially important to time: passage across meridian, marked by the mast.



"OUT OF THE FIELD!" Again, the button, as brief spectacle ends. These views exaggerate "moon's" brightness.

Star background: Yerkes Observatory photograph.

long row of wooden posts set into the ground. They serve as pedestals for a dozen observers' small telescopes. There's an inclined mirror at the front of each 'scope, so it can be used at a comfortable near-horizontal angle.

Seated in this "observing line," members of Wright's team adjust each 'scope by training it past the top of the meridian mast—which, with its crossbar, makes a vertical line bisecting the field of view. This done, they're collectively watching a long strip of the heavens along the celestial meridian. They hope a satellite can't cross this "optical fence" without being detected by at least one observer.

Their amateur-designed telescopes, which can be inexpensively homemade, now are favored over binoculars for Moonwatch teams. The instruments have a modest magnifying power of 5½ times. Their big advantage is their extra-wide field of 12 degrees. Thanks to this, as few as a dozen observers can cover a 90-degree sky strip, allowing generous overlap. And an observer gets precious additional seconds of time to detect a "moon" crossing his field of view.

Supremely important to observe, besides a satellite's "declination" or altitude in degrees as it crosses the meridian, is the precise time of the crossing. So a home-model tape recorder, set on a table beneath the mast, runs throughout the observing period of one to two hours. Beside it, a radio receiver is tuned to the time signals coming at one-second intervals from the National Bureau of Standards' station WWV. The tape simultaneously records the time signals, the observers' voices, and "beeps" from electric signal buttons—one of them within easy reach of each observer.

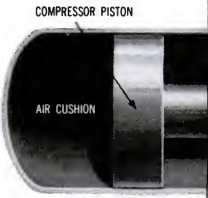
Take a typical evening observing session. Members of Bob Wright's team will assemble 15 minutes after sunset. They'll take their assigned places in the observing line, adjust 'scopes, sit and watch stars appear in the darkening sky.

Then, one of them may spot the electrifying sight—the moving, starlike satellite. What does he do and say?

He taps his time-registering signal button—and shouts something as informal, if he pleases, as "I got it!" Keeping an eye glued to his 'scope, he presses the button again when the "moon" disappears behind the meridian mast; when it reappears; and when it passes beyond the

[*Continued on page 291*]

'Engine of Tomorrow'



The chug-chugging free piston already powers ships and a locomotive, looks more promising for cars than the gas turbine. Cheap to make, it will run on almost anything that burns

By Harland Manchester

THE Ford Motor Company does not maintain a woodshed for lone-wolf inventors, but three years ago last February when Ford engineer Paul Klotsch wanted to build an engine he was brooding about, he found the next best thing—a neglected 10-by-15-foot shack at the Dearborn engineering center.

This engine was born in a shack

Klotsch, a gray-haired package of energy who once drove a plane in Baron Richthofen's Flying Circus in World War I, was steamed up about the free-piston engine. A cross between a diesel and a gas turbine, this hybrid had been installed in a number of French naval vessels, power plants and a locomotive.

"Mr. Free Piston" —Ford's Paul Klotsch— shows one piston of an engine developed from his pioneering work in an unheated shack at Dearborn

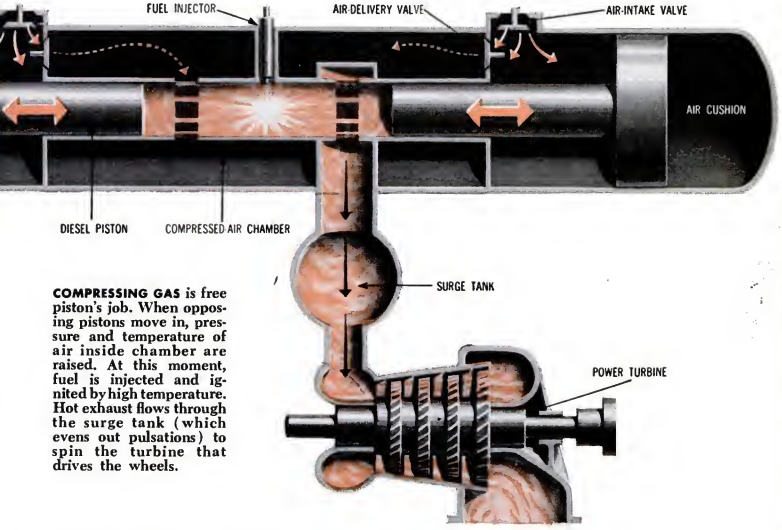
Klotsch had boundless conviction that the new engine had a big future in smaller sizes. Management was not much impressed, so in the true tradition of Henry I, Klotsch took over the unheated shack with three helpers. Wearing overcoats and earmuffs and working under a single light bulb that dimmed when they used power, they built the smallest free-piston motor that Klotsch could dream up. It was a 10-hp. job that operated according to plan, and Klotsch eagerly drew plans for other sizes.

Now Ford's hat is definitely in the free-piston ring, along with those of a dozen other corporations. Klotsch, manager of the mechanical department of the Ford Scientific Laboratory, has a large modern building full of the radical new engines in all shapes and sizes, and he is becoming known as "Mr. Free Piston."

An experimental free-piston engine rolled out last March in a farm tractor. It is called the Ford Typhoon. Considering it, without opening the hood, you'd see a neatly styled, 50-hp. beast that emits a sucking chug like an air compressor.

It thrives on any fuel: high-octane gasoline, diesel oil, kerosene, shale oil, butane gas or even peanut or other vegetable oils. In fuel consumption it matches the diesel, long

Goes to Work Today



COMPRESSING GAS is free piston's job. When opposing pistons move in, pressure and temperature of air inside chamber are raised. At this moment, fuel is injected and ignited by high temperature. Hot exhaust flows through the surge tank (which evens out pulsations) to spin the turbine that drives the wheels.

hailed for efficiency, and engineers are confident they can do better. It weighs somewhat less than a diesel and should cost less in mass production. It has virtually no vibration. And, most impressive of all for tractor use, it has superior torque at heavy load.

Ray J. Miller, General Engineering and Research Manager of the Ford Tractor and Implement Division, explains: "When you are plowing with today's reciprocating-engine tractor and you hit a tough spot, the engine slows down and you lose power at the wheels. If the going is tough enough you stall. With this engine, torque increases as the engine slows down, and the more you slow down, the harder it digs in to do the job."

When you open the hood, you see an engine like no other on earth. It has two basic parts: an opposed-piston diesel, called a "gasifier," which has no crankshaft or connecting rods, and a five-inch turbine, driven by the hot diesel exhaust. The horizontal diesel cylinder is shaped like a squared-off dumbbell and the pair of opposed free pistons can be likened to squared-off mushrooms whose stems face each other in the dumbbell grip. The pistons are forced together initially by a compressed-air starter, and fuel is injected into the super-

Free piston rides rails in France

Hardly an experiment, this locomotive has been speeding passengers from Paris to Cambrai in regular service since 1952

heated air between them. Driven apart by combustion, they bounce against cushions of trapped air at each end, and are driven together again to start another cycle.

The big outer ends of the pistons—the "mushroom caps"—do another job on the inward stroke. They force compressed air into a chamber around the cylinder. This blows through the cylinder when ports are cleared by the outgoing pistons, scavenging the gases and supplying pure air for the next combustion. Both gases and scavenging air are led to a "surge tank" that evens out the pulsations of the engine and delivers a continuous flow of gas to the turbine. In a straight diesel engine, the scavenging air is thrown away and its heat lost through the exhaust. This is one reason why Ford engineers believe the new engine may surpass even the diesel in fuel economy.

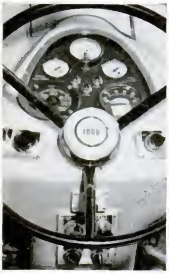
The mixed-in air does more than scavenge. When the gas hits the turbine blade, its temperature runs about 950° F. and this is important. It means that the turbine can be made of ordinary stainless steel, while the "pinwheel" for straight gas turbines requires expensive alloys to resist much higher temperatures. The "straight turbine" pinwheel currently costs about as much as an entire automobile piston engine, while Paul Klotsch figures that in orders of 60,000 Ford should be able to get its free-piston turbines for $18 each. Even if other things were equal, this might be the determining factor in any race between the two new power plants.

"This engine also solves the acceleration problem that bothers the gas turbine," said Ray Miller. "In the built-in fluid drive of the gas turbine there is an awkward time lag while the power turbine catches up with the compressor turbine. But the free piston, with its variable compression ratio, is so responsive that it accelerates even faster than a conventional gasoline engine. The free piston-turbine combination also has the equivalent of compression braking, for if you take your foot off the pedal and reduce gas pressure, you create a partial vacuum at the turbine and get a fast braking effect."

Free-piston engines now in use weigh much less than comparable diesels and somewhat more than gasoline engines, but Klotsch and Miller state that they are so amazingly adaptable that these comparisons have little meaning. The 50-hp. Typhoon engine will deliver 100 hp. with a few changes. "Broadly speaking," says Miller, "you could double the power of any free-piston engine by making the pistons lighter, perhaps using aluminum instead of cast iron, thus increasing the engine speed. This unique convertibility means that you could cover the entire range of automotive horsepower by means of variations on a standard-size engine.

"Another attractive feature is ease of maintenance. The

Ford tries out free-piston tractor

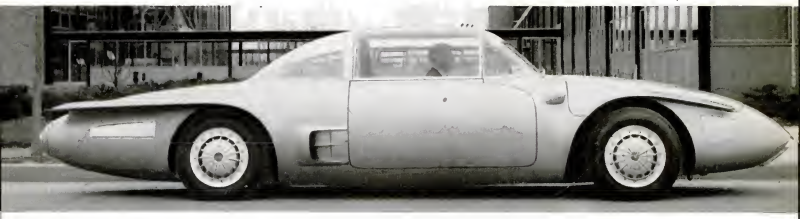


Strange cluster of dials (above) faces driver of experimental Ford Typhoon tractor. Big advantage of the chugging engine: It pulls hardest at slow speeds, when power is needed most

cylinders wear less because there are no connecting rods to impart side thrusts. There is only one injector, compared with one for each cylinder in the diesel. A complete overhaul takes only a fraction of the mechanic-hours needed for diesel or gasoline engines. No battery is needed for starting; when you kill the engine, compressed air is stored for the next start, so 'juice' is used only for lights and minor accessories.

"These are a few of the reasons why we think the free piston is a strong contender in farm equipment and in the whole diesel field. It may be years, however, before these tractors go on the market. We have a number of ideas for making the engine even better. As for the passenger car, we see no engineering reason why the free piston can't drive it, but the heavy-duty vehicle is our first goal."

GM keeps eye on road with free-piston car



Strictly dream stuff, the XP-500 has free pistons under the hood. But GM has already put bigger engine of same type in a ship, plans another for a locomotive

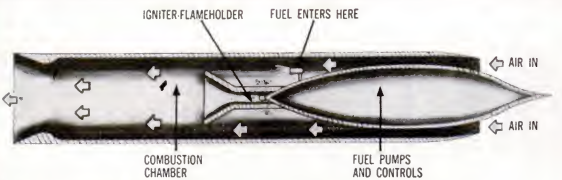
Meanwhile, General Motors, which last year put the free piston in a smartly behaving experimental passenger car, has gone to the other extreme. They've built a giant 6,000-hp. marine free-piston power plant, installed in the 9,000-ton Liberty ship William Patterson.

This power plant, designed with the aid of the French firm, SIGMA, has a battery of six free-piston diesels, or gasifiers, from which the gas is piped to two turbines that drive the propellers. The engine's versatility is shown in the reverse mechanism. A valve on the gas duct is opened to bypass the gas "around the corner" to a reverse turbine mounted on the same shaft. (The same ingenious method could be used if desired on automotive engines.) General Motors predicts that this power plant will be 20 percent more efficient than steam engines or gas turbines of the same size. Results of test cruises are expected by the first of the year.

"Many people seem to think this motor is still in the experimental stage," said A. F. Underwood, GM's Manager of Research Staff Activities. "Actually it has proved itself thoroughly, and is here to stay. At least a hundred are in daily operation in many countries, and a hundred more will be put to work before the end of the year. General Motors has tested free-piston engines for 30,000 hours, and we are convinced that they can furnish mechanical energy from liquid fuels at the lowest cost per horsepower of any engine.

"Years ago the Defense Department began looking for an 'omnivorous' engine that would lap up any fuel, and greatly simplify fuel-transport problems. This is the engine. If

[Continued on page 294]



Ramjet test missile takes off on supersonic flight

CARRYING a supersonic ramjet engine and a rocket-booster tail section, Lockheed's X-7 ramjet test missile is launched (right) from a B-29 over the test range at Holloman Air Development Center in New Mexico. In the inset it is shown in actual supersonic flight after dropping the booster tail. (Those are shock waves forming in the exhaust trail.)

Since ramjets have no compressor and depend for operation on ram compression of air by high forward speed, the booster is needed to bring it up to where the jet takes over. Cutaway shows how a ramjet works.

Both the X-7 and its tail section are recoverable by parachute. The test missile, controlled by ground radio, transmits performance data in flight. Smoke released from the B-29 simplifies optical tracking.

Blow-up cover for swimming pool lengthens season

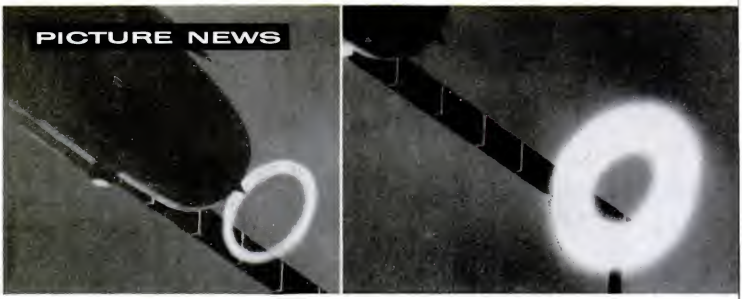
IN THE Buffalo, N. Y., area, where nippy temperatures come early in fall and stay late in spring, Walter Bird did something about the weather. He had his Birdair Structures, Inc., makers of air-supported buildings for radar and other uses, design a top for his swimming pool. The transparent plastic center admits sun, coated ends provide shade and privacy.

Multiple meters check costs of household appliances

A SEPARATE meter for each appliance-bearing circuit in his home gives Carl Kruempel, rural-electric manager at Independence, Iowa, a record of individual operating costs. Here's the breakdown for appliances used by his family of seven during the first year's check: television set (averaging six hours a day), $14.34; water heater, $81.69; furnace blower, $36.24; kitchen range, $37.65; refrigerator, $11.85; automatic washer, $6; dish washer, $11.52; and garbage disposer, 36 cents.

Rail-riding fork lift reaches into shelves 30 feet up

THIS West German fork lift, suspended from overhead rails, can move up and down to any shelf level, back and forth along the aisle, and to right or left, in reaching any storage space in the two 30-foot-high banks of racks it services. Its movements, including swiveling around the pole, are controlled by pushbuttons from the operator's cab.



Jet smoke rings help engineers "see" noise

INTRODUCTION of smoke into the jet stream lets engineers at Douglas Aircraft *see* the noise a jet makes and test devices for suppressing it. The blast is made to smoke by mineral oil injected into the air supply, and illuminated by a thin slice of light passed through at any

Cantilever canopy shelters park pavilion

A GRACEFUL cantilever concrete slab adds a modernistic touch to a new pavilion in Chicago's Lincoln Park. The structure, which cost $90,000, was donated by a chess fan, Laurens Hammond, head of Hammond Organ Co. It has built-in chessboards for rain-or-shine play.

point downstream. Photographed at far left is the exhaust of a standard jet one diameter downstream, and next, only slightly diffused, four diameters away. Above is the stream at the same points after installation of a suppressor. Engine roar is caused by the turbulence created as the jet exhaust shears through relatively still air.

Fourth-graders win chance to "fly" in old Link trainer

PUPILS in Jean Bryant's class at Chelsea Park School in Seattle learn to pilot early. Miss Bryant (left) persuaded parents and the school board to buy an old ground trainer to spur interest in lessons. Only students who complete their work and file a flight plan can "fly" it.

Air hammer wears muffler in hospital quiet zone

THE loud *rat-tat-tat* of a pneumatic hammer breaking up pavement is said to be effectively deadened by this jacket. Instead of the rapid-fire racket of metal on metal, noise is confined to the relatively soft thud of steel digging into concrete. Thor Power Tool Co., of Aurora, Ill., designed the sound squelcher for its paving breakers and diggers.

He walks on water with his duck-hunting skis

IT TAKES a little practice, but Daniel Fournier of Hamilton, Ont., finds these water skis better than wading to retrieve a duck or fish in shallow water. He built them of aluminum. Each weighs 12 pounds, has a flap on the bottom for "grip" as he moves with a sliding technique.

Double-dump truck hauls two loads on same trip

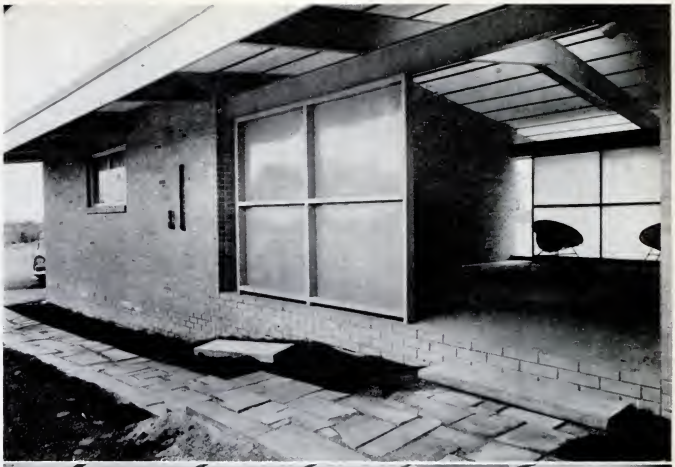
RIDING tandem over Utah roads, these light, aluminum dump bodies allow a double-load delivery of uranium ore per trip. On arrival, the driver dumps the rear unit by hydraulic lines from the cab; then jack-knifes the front one, and dumps it without running over either load.

Driverless 'dozer will tackle danger-zone jobs

WITH a radio receiver mounted in the driver's seat, this bulldozer can be driven by commands from a jeep or helicopter up to 15 miles away. Here Army engineers test it close up, guiding it by control buttons on a transmitter in the jeep. It's designed for construction work in radioactive and combat zones, and such jobs as fighting fuel fires.

"Spot wobbling" may rid TV picture of scanning lines

BELOW are two close-ups of the same television picture tube. Dark scanning lines in the one at left are what you see when you sit too close; at right they have been eliminated by wobbling the beam vertically 15,000,000 times a second as it darts across the screen. Westinghouse research scientists accomplished this experimentally by splitting the picture tube's spot-focusing grid and plugging the tube into a socket with a device to wobble voltage. Possible result: bigger picture tubes.



House of steel, brick and plastics uses no wood

EXPOSED beams in this house—built by architect J. Leonard Rush of suburban Detroit for himself—are light steel, spliced and welded at the center and supported by steel-pipe columns. The ceiling is the underside of fiber-and-cement panels topped with roofing of felt and marble chips. Some inside walls are brick, others are plastic on cement blocks.

EYEPIECE
MIRROR
OBJECT
MIRROR
MIRROR

Longest periscope aids test of nuclear plane engine

THIS 90-foot periscope, called the world's longest, lets engineers watch in safety the working of nuclear reactors designed to power aircraft. Paired with a 60-foot partner, it provides a view of both sides of a reactor in operation. Vision through both is bent around three

Grass "blotter" mops up rain to dry out golf-course turf

HERE'S one way to avoid postponing a game because of wet grounds. This power turf drier soaks up water with a roller made of a special Du Pont sponge and squeezes it into a storage reservoir. A vacuum attachment sucks puddles dry.

West Point Products, West Point, Pa., manufactures it for golf courses, tennis courts, baseball and football fields.

corners—with the aid of two 45-degree mirrors in the tube and a remote-controlled scanning mirror—to keep radiation from leaking through.

A third has a built-in camera for close-ups (like that of threading a needle above) of mechanical hands assembling parts in a shielded room. GE built them for the Atomic Energy Commission's Idaho Falls station.

Wheel spinning at 250 m.p.h. tests jet-plane landing gear

DROPPED under a 60,000-pound load onto a massive steel wheel rotating at the speed of a jet plane approaching a runway, the landing gear at right takes a ride that simulates what it would undergo on supersonic aircraft.

Bendix Aviation uses the setup to test shock-strut, wheel and brake assemblies at its South Bend, Ind., plant.

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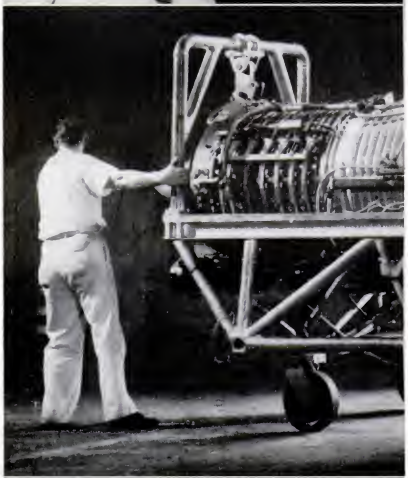
Lightweight engine can zip jets at double speed of sound

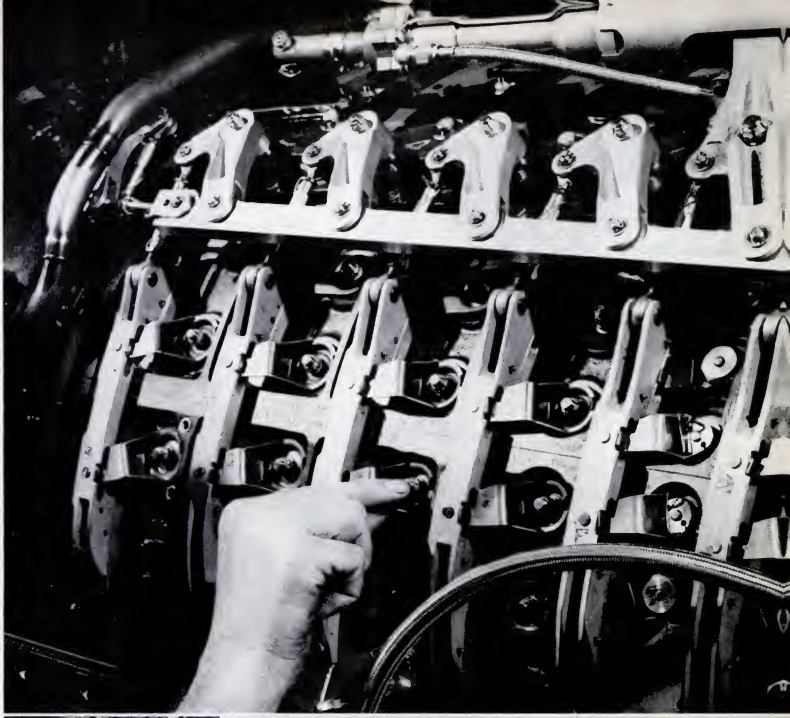
THE variable-pitch compressor blades at right, shown being adjusted, enable General Electric to lighten the weight of its J79 jet engine (lower right), giving it more thrust per pound of engine than any other big jet now in production. The engine can power aircraft and missiles at supersonic speeds.

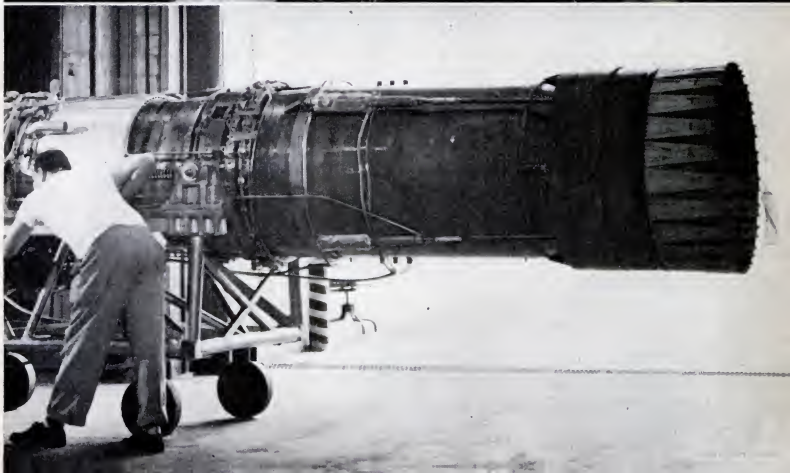
Pitch of the blades is automatically controlled as the speed changes, providing a smooth air flow inside the engine.

Rolling painter lines road fast

THIS self-propelled road marker can paint 22 miles of solid or broken stripe in a day. British made, it sprays paint between two rotating stencil disks. The operator can check on the line as it is laid by looking down through the frame.







Hot-oil pipe grid to keep sidewalk ice-free in winter

THIS network of welded steel pipes will form a heating system designed to lessen snow shoveling this winter. Embedded in the cement sidewalk in front of a building under construction on New York's Madison Avenue between 59th and 60th Streets, it will carry light oil heated to 140 degrees and pumped through when the snow begins to fly.

Radio controls camera to take close-ups from far off

USING a transmitter tuned to a receiver on this camera, you can click the shutter up to a mile away. This version of Standard Camera's 35-mm. Praktina FX is equipped with a radio-controlled motor having two solenoids: one to snap the shutter, the other to advance the film and cock for the next shot. The motor runs on batteries or house current.

Army can flash photo back from front in five minutes

PORTABLE Signal Corps facsimile equipment, using radio (as in the jeep below) or wires, can send a combat-zone or other spot photograph in record time to a point miles away. A Polaroid photo, developed in one minute, can be transmitted in three minutes to Polaroid film in a distant receiver and be converted there into a finished print in one minute more.

New Ideas from the Inventors

1 Idler Drives Tandem Wheels. A three-axle truck could get extra traction on icy or muddy roads with this inflatable, rubber-tired idler transmitting power from the driven to the follower wheels. On good roads, with the idler deflated, the truck would operate as usual with one powered and one "dead" rear axle.

2 Bottle Cap Encloses Straw. There'd be no need to hunt for a straw or cup if bottles of soda and other beverages came with their straws capped in. Formed with a high crown, this bottle sealer would leave space underneath for a drinking straw of exactly the right length.

3 Window Doubles as Awning. Hinged at the top, this tilt-out window could deflect rain and let air into a room at the same time. And with its shade drawn part way or fully down the length of the glass, it would serve also as an awning to block the sun on hot summer days.

4 Bumper Lightens Arm Loads. You might find it easier to carry a heavy object if you could keep it from banging against your leg or trying to trip you up. This cushioned bumper, shaped to fit between your waist and forearm, would help you support the weight, yet hold it clear.

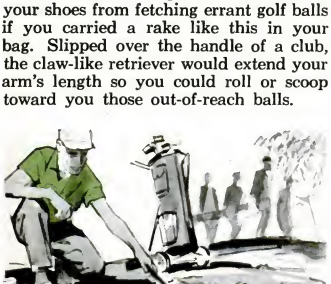
5 Tractor Level Eases Contouring. A farmer would find it simpler to guide his tractor over sloping or uneven ground with a level like this to point the way. The pivoted, counterweighted indicator would mark a horizontal course across a slope, or show the angle of a grade.

6 Shield Stops Bath Splash. With this splash shield hooked over the rim of your bathtub, you could scrub pets—or small children—and not get yourself all wet. And if you held a washed dog until he finished shaking himself off, the shield would also confine the splatters that usually hit the bathroom walls and floor.

Please turn the page for more new ideas

7 Drive Codes Taped Messages. To "scramble" a message on this tape recorder, you'd set a mechanism that would jiggle the tape as it moved past the recording head. The tape could be played back only on a duplicate machine set to repeat the same scrambling pattern.

8 Rake Retrieves Golf Balls. You wouldn't have to get sand or water in your shoes from fetching errant golf balls if you carried a rake like this in your bag. Slipped over the handle of a club, the claw-like retriever would extend your arm's length so you could roll or scoop toward you those out-of-reach balls.



9 Conveyor Brings Files to Desk. A file that had no bottom or top drawers could save bending and stretching. Occupying half the total space, the drawers in this cabinet would ride on a conveyor. Pushing a button would bring the tray you want to the desk-high opening.

The following patents *have been issued on these inventions: 1. Patent No. 2,717,654 to L. Andersen, Richfield, Minn.; 2. No. 2,718,968 to A. Attler, Yonkers, N. Y.; 3. No. 2,718,259 to E. G. and E. W. Smith, College Station, Tex.; 4. No. 2,707,071 to D. Adams, El Monte, Calif.; 5. No. 2,669,737 to E. Wetzig, Sr., Carrizo Springs, Tex.; 6. No. 2,725,576 to C. Schwersinske, N.Y.C.; 7. No. 2,730,569 to C. Street, Stamford, Conn.; 8. No. 2,721,755 to W. Walner, Norfolk, Va.; 9. No. 2,758,901 to F. Cole, Jr., Manchester by the Sea, Mass.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

PS writer-photographer team gives you an eye-witness report on our anti-sub program in an attempt to answer a vital question:

Can We Defend Our Coasts Against Russian Subs?

The Navy's newest sub-killing destroyer makes a furious turn to dodge an incoming torpedo in Key West maneuvers

By Frank Harvey PHOTOS BY W. W. MORRIS

IN THE last war, it was sometimes possible to read newspapers at midnight on New Jersey beaches—by the light of burning American tankers. With less than 200 U-boats, the Nazis were sinking our ships as fast as American shipyards could bash champagne bottles over their prows. Those U-boat skippers had no homing torpedoes, long-range sonar, or atomic missiles. They just eased in out of that big dark Atlantic, upped their attack periscope, and let fly.

Now we have a problem: 400 Russian long-range submarines with homing torpedoes, sensitive sonar, and a fiendish ballistics missile called the Comet, said to be able to dump atomic warheads on any American city within 700 miles of the 20-fathom water that rims our continent.

If World War III broke out tomorrow, what sort of defense could our Navy put up against the Russian submarines?

The answer is certainly not as bright as we'd like—but it's not pitch dark, either. For one thing, we'd know the subs were coming. Reportedly, the U. S. Navy has already installed an extensive underwater warning line similar to the chain of radar stations that the USAF has strung across the gateway to the Pole. The underwater warning system is said to be made of highly advanced sonar devices tied together in long chains on the ocean floor up and down the Atlantic and Pacific seacoasts. Any enemy sub that tries to sneak over

the sonar chain will unwittingly send its calling card many hundreds of miles ahead so that Navy reception committees of ships and planes may be on hand with the latest weapons to greet the visitors.

(Zipper-lipped about this underwater sonar chain, the Navy will not confirm that it exists. Guardedly it says: "A mass movement of submarines would no doubt be detected and reported long before they could reach U. S. coastal waters.")

How hot a reception would these underwater visitors get?

To find out in detail, POPULAR SCIENCE sent photographer Bill Morris and me to Key West, Fla., headquarters of anti-sub activity on the Atlantic coast. A huge sonar school at Key West is grinding out a steady stream of officers and men trained in hunting, chasing and blowing enemy submarines to bits. Their new weapons are good—and better, fearsomely potent weapons are on the way. Let's start with the time-honored workhorse of anti-sub warfare, the destroyer.

A new destroyer has been designed with one thing in mind: sub killing. It can turn on a dime, can actually dodge torpedoes like a clever halfback in an open field, and is equipped with listening gear so sensitive that shrimps may be heard feeding, guppies mating, and subs snorkeling at incredible ranges. A second type of sonar sends out continuous underwater signals that bounce off a whale's belly or a U-boat's flank and come back as a "ping" that gives an instant range and bearing on the unknown. The destroyer skipper can attack in a split second with all the weapons at his disposal.

Weapon Able—standard equipment on the new destroyers—is a giant depth-charge gun that can hurl huge packages of explosive a long way from the ship at a high rate of fire and with excellent accuracy.

It has been reported—without official confirmation—that the Navy has a ferocious atomic depth charge that is so powerful it must be dropped from airplanes and will kill any sub unlucky enough to be within half a mile of it.

Homing torpedoes (the Navy has a whole family of different types that may be dropped from helicopters, planes or ships) chase down the submarine with sonar brains, like a ferret closing in on a rat.

Destroyer kill techniques, as might be expected, have sharpened considerably since World War II. The sonarman picks up the enemy, shoots the exact position to the radar controller sitting near him, and the radar controller, in a Tinker-to-Evers-to-Chance play, vectors a hovering helicopter to the spot. When the sonar blips of the submarine merge with the radar blip of the attacking whirlybird, it's just depth charges away. Best part of this attack is the fact that the marauding sub never even knows he's under attack until his conning tower caves in like a can of vegetable soup.

High-speed fixed-wing airplanes carry out a variation of the helicopter attack, at night, against snorkeling subs. The plane roars in, depth charges ready, being directed by its own radar. When the submarine blip is directly ahead and just a few seconds away, the pilot turns on a searchlight only slightly less powerful than the sun, leans forward and his eyes strain to catch that telltale "feather." If he sees it, he punches the pickle, releasing his bomb, and makes his

Weapon Able—a new gun

that flings huge depth charges great distances at high speed—is the newest destroyer armament.

circle to pick up the oil slick. This attack sounds red-hot, but it's no better, however, than the "Mark 1 Eyeball," because you can't bomb something you can't see—and you have seconds for the pickup.

But the Navy has still further loaded the dice against the snorkeling sub by denying him the use of his radar through Electronic Counter Measures. ECM is simply a very sensitive pickup to snag radar emanations so they won't bounce back to the enemy's screen.

Submariners are unanimous in saying that they'd rather be attacked by a whole flotilla of destroyers and a skyful of airplanes than by an "anti-submarine submarine." One of the great protections any sub has against surface sonar is the so-called "Thermal Layer"—a level in the sea where the water takes a sudden change in temperature. This layer bends the sonar beams radically. Any sub lying under the layer (which averages about 90 feet down) is almost impossible to detect.

VETERAN INSTRUCTOR demonstrates how an enemy sub shows up on a sonar scope in Key West school. Students look, listen, then go to sea and "fight" with a real live sub.

Not so when he is being stalked by another submarine which is also under the thermal layer. One technique for a killer sub is to lie doggo under the layer in an area where enemy submarines are likely to appear. He has his listening sonar (a supersensitive hearing aid) turned to high gain. When he hears the enemy sub at a great distance, he quickly works out its range and course, by a secret computation, using sound alone. If the enemy is headed toward the killer all he need do is wait for the proper moment and fire. If the enemy is headed elsewhere, the killer sub may rise quietly to the surface and radio the position of the quarry to circling planes.

These planes are equipped with MAD gear (Magnetic Airborne Detection) with which they can "pin down" the submarine until destroyers arrive to sink it. Blimps are also used to tow sonar teardrops at great depth—under the thermal layer—and serve as director stations for the killer subs.

Anyone reading this article might by now have decided that the Navy has it made as far as killing enemy submarines is concerned. But the ocean is very very big, and the submarine, by its nature, almost always has the initiative. If it's merely a question of protecting convoys, then the Navy's new techniques are excellent. I stood on the bridge of one of our latest anti-sub destroyers, the USS Cromwell, off Key West, while some of our most talented submarine skippers tried to get through the screen to hit the "carrier." We dodged tin fish with ease. We "sank" two subs. The destroyer serving as the "carrier" churned blithely through the attackers without a scratch.

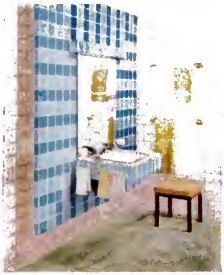
Missile-launching submarines are another kettle of fish. They will not be used, of course, if future wars are confined to "brush fire" dimensions. But both our own high command and the Russian leaders have repeatedly served warning that "quality weapons will be used from the outset" in any serious outbreak of hostilities. Quality weapons is a cleaned-up term meaning H-bombs. It isn't pleasant to think of 400 Russian submarines surfacing in unison some dark night off our coastlines and letting fly a sudden shower of Comet missiles with atomic warheads. Our warning net might have alerted us to their presence. But our defensive setup today, as made public, appears inadequate against a concentrated guided-missile launch from offshore submarines. END

NEXT MONTH IN PS: How research chemists developed the super-potent "zip" fuels that will drive our jets and missiles faster than ever and twice as far

Interior designs by John and Earline Brice.

BEGIN WITH A BEAUTIFUL BACKGROUND *of plastic wall tile*

IDEA! A panel of blues in classic design on a wall of white Styron plastic tile.



MADE OF STYRON A DOW PLASTIC

Play up a divider wall! This cheerful contemporary kitchen began with plastic wall tile made of Styron®. Creamy yellow and white squares for walls and counter facings . . . king-size blue squares to accent the divider wall with its butterfly motif in white triangles. The dozens of decorator-styled Styron colors and varied tile shapes will inspire decorating ideas that are as practical as they are beautiful for your whole house. For your certified dealer can guarantee the quality of Styron plastic wall tile and installation. Whether you're building, remodeling or decorating, see your dealer soon . . . and begin with a beautiful background of Styron plastic wall tile. Send 10¢ for a colorful portfolio of designs in plastic wall tile. Plastics Sales Dept. PL 1564T, THE DOW CHEMICAL COMPANY, Midland, Michigan.

YOU CAN DEPEND ON DOW

HERE WAS THE

PROBLEM

1. Drab, colorless kitchen
2. No counter space
3. No cabinet space
4. Tight budget

HERE'S THE

SOLUTION

Working evenings and week-ends, an amateur with no previous carpentry experience, worked this happy change. He bought ready-made birch cabinets, inexpensive hemlock tongue and groove lumber for paneling and used 2 x 4 framing. For $53 he purchased enough Formica and Formica Contact Bond Cement to surface the snack bar, the sink top and the wall area behind the sink. He used Formica Red Capri #33-PR-1. He cut the Formica to size with a hand carpenter saw, used the spreader furnished with the cement and rolled it down with his wife's rolling pin.

And Here's the Formica Commercial—Formica is beautiful. It lasts a long, long time. It's easy and fun to apply. It comes in more than 70 colors, patterns and wood grains. There is only one genuine Formica and the name is printed in washable ink on each sheet. For your Formica dealer, look in the yellow pages of your phone book under "plastics."

FREE! Easy, step-by-step picture instructions for applying Formica to sink tops, furniture and many other surfaces. Write Formica 4726-7 Spring Grove Ave., Cinti. 32, O. and ask for form #359. *In Canada: Arnold Banfield & Co., Ltd., Oakville, Ontario.*

Customers buy Formica because it is a brand name they know and trust

DEMAND THIS CERTIFICATION

We protect this faith in our product by certifying every sheet with a wash-off Formica marking. It is for your protection and guarantee that you are getting genuine Beauty Bonded Formica.

This mark certifies genuine

RUB OFF WITH LOTS OF BAR SOAP ON A DAMP CLOTH

Guaranteed by Good Housekeeping

Subsidiary of CYANAMID

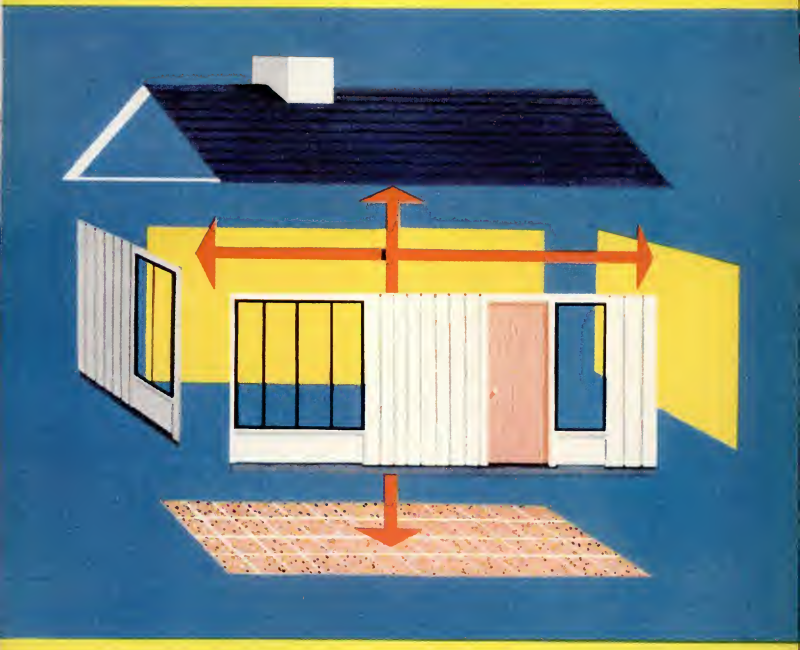
Beauty Bonded FORMICA® Laminated Plastic Pays in Performance

Seeing is believing. If this wash-off identification is not on the surface, it's not FORMICA.

New Living Space for Your Home

Home and Shop

...where to find it ...how to add it



- Raise the roof
- Build an addition
- Panel the basement
- Enclose the porch
- Finish the garage
- Try room dividers
- Knock out surplus partitions

How to Shop Wisely for Loans, Labor and Lumber

YOU can save up to 50 percent on the cost of home improvements by doing your own work. But you can also relax in the back yard while others do the hard work—and still save money.

Here's how:

• Be your own contractor. Hire the mason, carpenter, electrician and so on yourself. You may save up to a third this way. Find out by getting estimates for all separate jobs. Compare the total with the best overall contract bid.

• Shop for the best loan. This can save you hundreds of dollars in excessive interest or back-breaking payments. Some loans require costly plans that may not be necessary. You can save up to 10 percent if you don't need them.

• Get at least three bids on anything to be done or bought.

• Steer clear of cost-plus deals. Cost bills can be padded. And be wary of a contractor who asks money in advance.

• Have all costs and specifications in writing and signed before work starts. Misunderstandings can be expensive.

• Take advantage of quantity discounts and "cash-and-carry" plans. Many lumberyards offer a five-to-10-percent discount if you buy materials in bulk or carry them home yourself. Some dealers may also let you spread a bill over several payments without charging interest.

• Use the cheapest grade of materials that will do. On many finishing jobs, structural strength isn't as important as in original construction, and lumber can be of lower quality.

• Plan ahead. If a new room will need heat, find out if your present system is adequate. Avoid costly errors by planning a logical sequence of construction.

• Protect yourself against the chance of expensive accidents on the job with liability insurance, and be sure that workmen are covered by compensation.

The painless way to pay. You'll spend more on a long-term loan stretching over years, but payments are a lot easier.

With an "open-end" mortgage, you can often re-borrow up to the amount you've already paid off. Veterans with VA mortgages can sometimes increase loans similarly.

The added payments are low—for $4,000, probably about $30 a month. But you'll have to submit plans and may not be permitted to do any work yourself.

If you have a standard mortgage that's low—or none at all—you may be able to get a new long-term mortgage. In this case, the bank lends you the money on your present property and doesn't usually care how you spend it.

Because of rising interest rates, however, a new mortgage will probably cost you more than your old one. Figure the difference, and add in the legal and other fees, which may run to $200 or more. You may find it more profitable to try to swing a short-term loan.

On some life-insurance policies you can borrow up to the cash-surrender value. The interest rate is five to six percent, but your money continues to earn dividends at about two percent, so the actual rate is only three to four percent.

There's a temptation, however, not to pay an insurance loan back since you aren't required to (the loan is deducted when the policy is paid). Unless you re-

KEITH WARP

pay it promptly, you'll pay years of interest to borrow *your own money.*

Short-term non-collateral loans. These cost you less, but payments may be steep. Usually, the most you can borrow is $5,000—in some areas $3,500—with up to five years to repay.

Interest rates are sometimes misleading, so know exactly what you pay. On a 4½-percent installment loan—the kind you pay back every month—the actual interest rate is about double the advertised interest because you're charged the full rate even on the money you repay.

On finance-company loans—the kind that come with a "we're your pals" pitch—the interest may be "only" 2½ percent, but it's 2½ percent *every month.* It could cost you *30 percent a year.*

Always find out exactly how the interest is figured. You shouldn't have to pay more than four to six percent a year. FHA loans start at five percent on the first $2,500, then drop to four on the next $1,000. On a three-year loan, you repay about $32 a month for each $1,000.

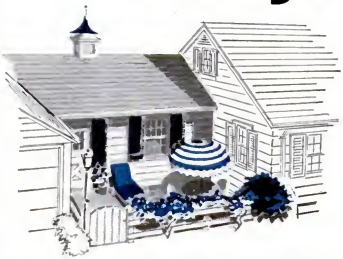
FHA loans are sometimes easier to get than a bank loan, but you pay an extra ½-percent interest for insurance, and the terms are very strict. You have to submit plans and can't buy anything removable, such as a refrigerator. Banks giving conventional loans are much less fussy about how you spend the money, and such loans are available at the same or lower rates.

Often you can save even more on a *personal* loan. If you want $2,500, one New York lender requires 24 payments of $114.71 a month on a home-improvement loan, but only $113.85 on a personal loan—saving more than $20.

Collateral loans. Instead of selling stocks or bonds to get money, you can often put them up as security for a collateral loan. The advertised interest rate is higher than on straight loans—usually six percent—but it's a true rate. Your stocks or bonds are earning money meanwhile, so the actual cost of the loan may be only one or two percent.

Collateral loans are commonly made for three or six months. At the end of a period, you pay off the loan or extend it for another period. The advantage is that you can borrow a little money as needed if your project spreads over a year or more. You don't pay interest on money that you won't use right away. END

6 Ways



YOU can find additional living space in your present home in one or all of six different ways. You can:

1 ***Use all your space all year.*** During the cold months, an open porch or breezeway is just waste space.

In each case you already have a floor and a roof. Add walls, extend your heating lines, and you wind up with a low-cost, year-'round addition—new space for a new bath, bedroom, dining room, whatever you need.

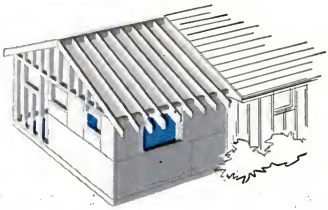
Breezeways seemed a fine idea a few years ago. But one by one, as families have grown, the breezeways have been walled in, front and back, for useful living space. Car ports can sometimes be adapted the same way.

2 ***Establish living quarters in space that's now inefficiently used—a garage, basement or unfinished attic.***

Moving into the attic or basement—often used for nothing but dead storage—has the same effect spacewise as adding a second story.

If your space needs are really urgent, parking a car in a garage is the poorest

to Add Living Space



kind of economy. With a garage, you are well on your way to a spacious addition. Regular coatings of preservative car wax are far less expensive than building an addition from scratch.

3 ***Add to the actual cubic footage of space within the house.*** A sideways extension will do this, as will raising the roof to use an attic where the present headroom is too low.

The latter is often accomplished by raising all or part of one side of a gable roof to a dormer position. Of these two ways of gaining space, the roof raising is much less expensive.

4 ***Rearrange the interior walls.*** You may desperately need space in one part of the house but have room to spare in another part. The walls are just in the wrong place.

Rearranging walls can be very simple or very tricky, depending on whether they are load-bearing. Usually, walls that run in the same direction as the floor and ceiling joists are non-load-bearing, and can be safely removed.

A movable room divider often gives better use of a large room. A divider that stops short of the ceiling gives a room an open feeling that makes it seem larger than it is.

5 ***Make some rooms do double duty.*** A separate dining room is often used for only one meal a day. It might also serve as a sewing room, TV room, even as a guest room or laundry. Such doubling up sometimes frees space elsewhere in the house for more urgent use, perhaps as a new bath or bedroom.

6 ***Install modern storage units.*** Well-planned closets and storage walls can actually make more *living* space available.

Storage-wall units can give as much square footage as an ordinary closet and save floor space besides. Here's why:

The back of a storage-wall unit is usually a sheet of plywood or hardboard, no thicker than half an inch. Backs and fronts of an ordinary closet are full partitions, five inches thick. Add the difference in both front and back, and a storage-wall unit could save as much as nine inches—¾ of a square foot of floor space for every running foot of closet.

You Can Live in the Basement Now

An underground movement in homes is under way. Here's a down-to-earth report on it

MODERN building methods and materials can make a basement just as livable as space above ground. Yet most homeowners let this valuable living space go to waste.

Need an extra bedroom? Put it in the basement. Many people have.

Looking for space for a family room, playroom, large dining room, laundry, darkroom, workshop? You can probably find it in the basement.

In a one-story house, a basement occupies almost half the total cubic footage. Put the basement to efficient use and you are in effect adding another floor to the house.

Consider these points:

- It costs only $1 to $2 a square foot to add living space to the basement compared with $10 to $15 above ground.
- The construction job is easy because nothing you do in finishing a basement affects the basic structure of the house. The walls, floor and ceiling are already in—you just cover them over.
- Modern basements have higher ceilings, more windows. They're no longer dreary. Clean, compact heating plants can be partitioned off, out of sight.

Problems solve themselves. Just finishing off a basement in itself may cure conditions of cold, dirt and dampness. As you cover up the walls, floor and exposed pipes, you make the cellar warmer, seal out dust and eliminate the cold surfaces that cause condensation.

Substitution of fluorescent fixtures for old bare bulbs often transforms a cellar into a bright, cheerful room without requiring new wiring. Acoustical ceiling tiles are handsome yet inexpensive, go up fast and help deaden basement noise.

Adding heat isn't as difficult or expensive as it may seem. New registers can be

DINING ROOM is cool for summer entertaining, warm and rustic for winter use. Walls are rough-plastered and studded with random half logs. Alternate pairs of ceiling joists are boxed with plywood for a heavy beamed effect.

BEDROOM—proof that you can sleep in the basement, too—serves guests or a bulging family. Walls have insulation batts stapled between studs and are covered with inexpensive plasterboard panels prefinished to look like wood.

LIVING ROOM is as fancy as you could wish—yet it's in the cellar. Painted lally columns, combined with decorative poles and planting boxes, help screen room from other areas.

GAME ROOM provides activities for the whole family. Ping-pong table doubles for dining, can be pushed aside for dancing. Foot-thick storage wall hides heating plant at rear and houses books, phonograph and record cabinets.

TV ROOM has set built into a wall, keeping floor clear for other activities. Space for set is made by carrying wall paneling across an alcove, which also hides water pipes and gives room for additional shelves and storage cabinets.

SHORT TWO-BY-THREES fill gap at edges of the ceiling where the joists run parallel to the foundation. New wall framing can then be fastened to them. Make use of similar filler blocks where a partition falls between two joists.

JUMBLE OF PIPES can be neatly enclosed with a frame suspended from ceiling joists this way. Bottom can then be tiled to match the ceiling. Where pipes cluster, a single enclosure is better looking than individual pipe covers.

cut in existing warm-air ducts that run along ceiling joints. Special finned convectors are also made to clamp on exposed steam or hot-water pipes and deliver heat directly to the cellar.

If excessive moisture results from scant ventilation, you can mount an ordinary window fan or an exhaust fan in the wall. An electric dehumidifier will draw gallons of water from the air daily. Dehydrating chemicals also help.

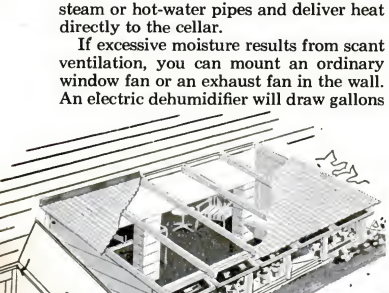
Moisture from outside can be stopped by painting the masonry walls with a bituminous coat before you cover them over. And use the type of insulation that has a built-in moisture-vapor barrier on the side facing the room. This will keep inside moisture from getting behind your wall to cause rot and a musty odor.

How much will it cost? Finishing costs usually fall into three groups according to typical prices. Using the least expensive materials, you can spend as little as $200 to $300 to finish a 16′-by-20′ basement room; $300 to $500 using medium-priced materials; and up to $700 or more for special paneling and built-ins.

Here's how the main items break down:

The basic framing is the same no matter what you put over it. For a 16′-by-20′ room, you'll need about $40 worth of wall studs and $15 worth of one-by-two furring strips to mount ceiling panels on. You may spend even less for studs if you can use odd-lot 7′ lengths, which are cheaper than cutting up 8′ or 14′ pieces.

To cover walls, large sheets of plasterboard or hardboard, at five to eight cents a square foot, are the least expensive. You could completely panel the same 16′-by-20′ room for $30 to $40. For $100 to $150 you can use solid wood paneling, such as



You can enlarge a basement

A GOOD BASEMENT is sometimes worth making even better instead of building a more expensive addition above ground. One way to gain light, air and more space is to add a plastic-roof enclosure like this. Masonry or steel piers can be substituted for the foundation wall.

What to do where on a typical basement-finishing job

SMALL DOORS like this make it easy to reach meters, fuse boxes and other controls without leaving them exposed. Hinged panels made of the same material as walls are almost invisible.

knotty pine, or several types of softwood plywood. These cost 20 to 30 cents a square foot. Still fancier are hardwood plywood and plastic-faced panels at 40 to 60 cents a square foot.

Acoustical ceiling tiles range from 12 to 15 cents a square foot, so that a 16′-by-20′ area would cost $40 to $50. Many plywood and other decorative panels for walls also come in convenient squares for ceilings at 25 to 35 cents a square foot. For a low-cost ceiling, plasterboard and hardboard can be used at half to one-third the price of acoustical tiles.

Ceiling light fixtures, made to fit between the joists, cost $5 to $10 for a single-bulb, recessed type, $15 to $25 for the larger fluorescent units.

What kind of floor? Until recently, only asphalt tiles were recommended for use below grade on concrete. They're still cheapest and serve well. For a 16′-by-20′ floor, you'll spend only about $35 for some dark colors, including adhesive to lay them, and about $50 for the more decorative light colors.

For about twice the price of asphalt, you can use the newer vinyl-asbestos tiles that are now made for basement floors. These provide a more resilient, longer-wearing floor than asphalt.

For tops in luxury, many lumberyards now carry specially treated hardwood parquet floor blocks that can be set in mastic directly over concrete. These come in 9″ squares and cost about 60 cents a square foot.

Basement with a view? Instead of small window wells that collect leaves and trash, you can cut away a strip of earth about 2′ deep and 4′ to 6′ wide along the outside of the foundation. This will let in more light and air and, if planted with small trees or flowers, will give you a garden scene from the cellar.

Additional windows are not hard to install if you stick to the small basement type. These have self-supporting steel frames and can be cemented into openings at the top of the foundation without special framing. A row of these, several feet apart, provides an effect very similar to the high, shallow windows found in many modern homes—upstairs.

Studs or furring strips? Wall paneling is sometimes placed on one-by-two furring strips, but you'll have a warmer, drier basement room if you use two-by-three studs. They cost a little more than furring strips, but provide considerably more insulating space between old wall and new.

Studs simplify construction, too. Nailed only at the top and bottom, they're easy to set straight. Furring strips, fastened directly to the concrete, follow the irregularities in the wall and make it harder to get a flat surface.

Because the finish walls support no house weight, there's a trick you can use to save work and time. Instead of resting the studs on a thick sill, which is hard to bolt to the floor, a thin one-by-four board is first spiked to the concrete. Directly overhead, marked by a plumb bob, a second one-by-four strip is nailed to the ceiling joists. The studs are then held by spacer blocks between these two top and bottom strips. The blocks, all cut to the same length, automatically space the studs the correct distance apart and eliminate having to toenail the ends of the studs.

With studs set 24″ apart on centers, you can put up 4′-wide sheets, with a support at the center and edges of each panel. For squares and planks that come in 16″ widths, space the studs 16″ apart. For narrow boards, studs can be up to 3′ apart, with furring strips nailed horizontally across them. END

Installing a New Basement Door

BASEMENTS are sometimes built these days minus an outside entrance, but you don't have to continue living with such an inconvenience. One contractor adds a new entrance for around $300, including a factory-made steel hatchway.

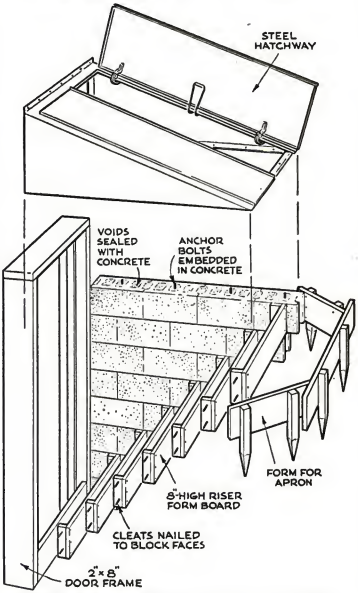
Doing the job yourself, you can expect to get by for $100 less. Here's how:

First, determine what size hatch you'll need to cover stairs sloped at 45 degrees to the basement floor. Then dig out a sloping area where the hatchway will go.

A rented electric hammer will make quick work of knocking an opening in the foundation wall, even if it is of poured concrete. With a cinder block wall, you can get by with a hammer, cold chisel, and goggles.

Use concrete blocks to lay up the side walls, starting with shallow, step-like beds of concrete. Fill voids in the top courses, embedding anchor bolts where needed for the steel hatch. Nail cleats to the walls to hold the riser form boards. Erect form boards for the apron.

Pour concrete behind the riser form boards, working up, step by step. Then pour the apron. Drill holes at the head of the stairs and insert plugs to take the expansion bolts that hold down the hatch sill. Lower the hatch into position over the anchor bolts. Use anchor screws to attach the rear of the hatch to the house. Frame in the doorway with two-by-eights and hang a heavy door. END



CONCRETE STEPS are poured directly on inclined earth excavation by one contractor (below). Cleats on the side walls hold riser form boards.

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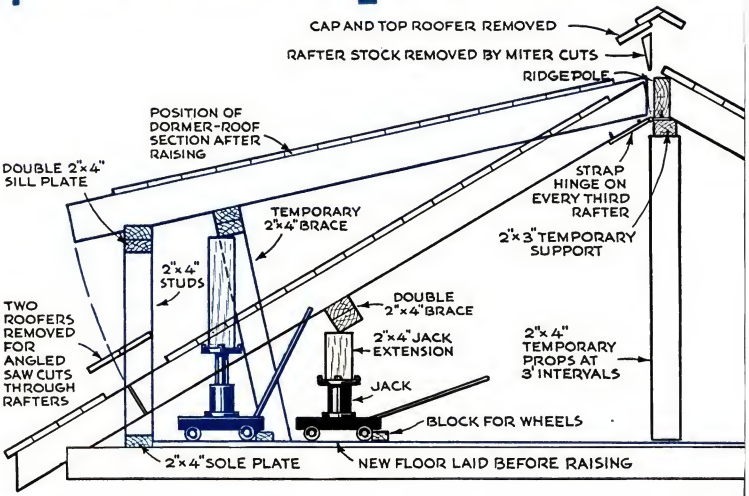
2



IN THREE days, the house pictured above gained a second story. Raising the roof turned an unusable attic into two spacious bedrooms and four big closets.

Shingles were removed around a 10′-by-25′ section of roof (1), and the rafters were mitered and hinged at the ridgepole. Then a wheeled car jack (rented from a garage) began raising the hinged flap (2) to dormer height. Studs were driven in (3) and windows installed. Sheathed and flashed (4), the new dormer was then ready for finishing (5).

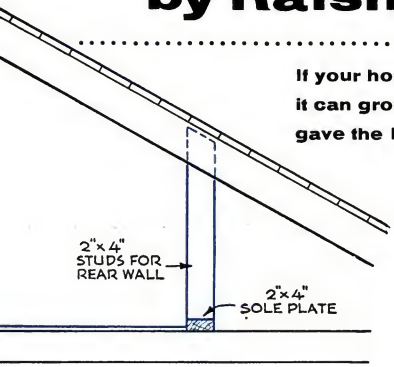
The change was made over a single long weekend on the home of Mr. and Mrs. Leonard Baltz Jr. in Clifton, N. J. Like thousands of others these days, they wanted the greatest amount of new space in the easiest way at the lowest cost. The dormer was the answer. It came close to

3

4

Expand Your Attic by Raising the Roof

If your house can't grow sideways, maybe it can grow upward. Here's how a dormer gave the Len Baltzes two new bedrooms



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doubling the living space in the Baltz home.

Roof raisings like this are becoming a popular way to solve the space problem. One major contractor has been averaging two dormers a day. In one community, 2,000 homes have already been converted from one to two stories.

It's easy to see the reason for this boom in dormer construction. Of the two

WHAT THE BALTZ FAMILY GOT: Two spacious rooms like this one are each 15′ square and have large storage cabinets under roof eaves. Stairway at left is screened off by decorative shelves made with closet-pole posts. Total space: 3,500 cubic feet. Total cost: $705.

ways you can expand your house—upwards or sideways—a new top floor gives you the most for your money. The way it was done on the Baltz house, you need only enough lumber to frame in under the lifted roof and for partitions. Finishing off the inside costs no more than doing the same job inside a conventional expansion attic.

Doing the work himself, Len Baltz spent $265 to raise his roof—including $65 to a helper—plus $440 to finish the interior. Even doing no work yourself, prices for raising a roof, at the Long Island rates, start as low as $350.

With a dormer, you bypass many of the expenses of a separate addition—you already have the foundation, roof and most of the walls. It takes up no yard space and is easier to keep warm since you now use a lot of heat that's ordinarily lost through the roof. If you want a bathroom, you can often locate it over one downstairs and run new pipes only a short distance upward.

Three styles of dormers are commonly built. The setback type starts at knee-wall height up the roof and gives you one window in a bathroom-size space. The Baltz type usually starts 1½′ from the front or back of the house and extends to within one rafter space at each end of the roof. A flush dormer raises all of one side of a gable roof.

Even a second floor that already has the small type dormer can be greatly improved. You can raise the roof between two end dormers, or expand a central one from each side, and make one long dormer with full ceiling height.

In the Baltz job, horizontal two-by-sixes were spiked across each pair of rafters after the hinged roof section was raised. These lock the rafters in their new position and form ceiling joists. They were placed as high as possible for maximum headroom, but below the attic air vents. Insulation was then run between the joists so that heat is kept within the new room without interfering with ventilation between the ceiling and the roof peak. END

Why Not Expand into the Garage?

Need more ground-floor living space? A remodeled garage is your big economy package

WHEN you convert an attached garage into additional living quarters, you pocket at least $2,000. That's the money you don't have to spend for costly exterior work—excavation, foundation, framing, sheathing and roofing—on a new house wing of equal size.

Garage space is *big* space. The average single-car garage measures about 10′ by 20′. Depending on your needs, you might convert this space into:

- An expansive family room for the overflow of household activities.
- A dining room and pantry, to take the place of a cramped dinette.
- A master bedroom and bath.
- Two medium-size bedrooms.

If you own a two-car garage, you can pick up the equivalent of a small cottage in new living area. Or, if you want to keep one car indoors, the obvious solution is a fireproof partition to cut the garage space in half.

A separate garage with a connecting

TRACT HOME ON A SMALL LOT may offer only one solution for a family that's bursting at the house seams—a garage conversion. Here's how the David Wardells, of Glen Ellen, Calif., gained 264 square feet of floor space for a family room. Cost of necessary materials was only $337.

How you can convert three types of garages

BREEZEWAY-ATTACHED: This is a natural for new sleeping quarters on the ground floor. A hall at the back of the breezeway gives complete privacy. Bathroom is accessible from outdoors.

SINGLE: Here, the kitchen becomes a desirable buffer between formal and informal living quarters. Being next to the kitchen, the family room can also serve as handy utility space.

DOUBLE: This is a compromise conversion. By breaking through a hall-closet wall, the one-car garage can still be reached from indoors. The new bath serves both bedroom and kitchen.

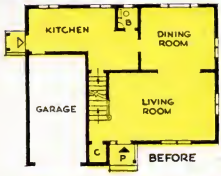
breezeway is another potential space maker. Just closing in the breezeway may give you all the additional room you need. Again, you may want to retain part of the breezeway as a porch, enclosing only a corridor to new living quarters in the garage.

But before plunging into any garage-remodeling job, here are a few things to consider:

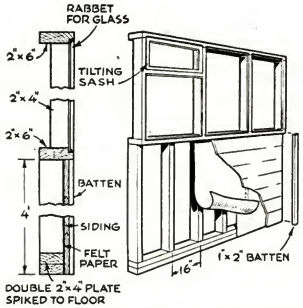
Closing in the door opening. The average single-car garage has a doorway approximately 8′ wide. That gives you an opening for a picture window large enough to "daylight" the entire garage area. It is also one of the many places where you can hold costs to a minimum, or splurge, as you like.

In southern climates you can build a wall from garage-floor level to window-coping height, and frame and single-glaze the opening above it, for less than $50. Elsewhere, the exterior wall will have to be set on a footing poured below frost line. But you'll still be ahead of the game if you frame the opening for stock window sash.

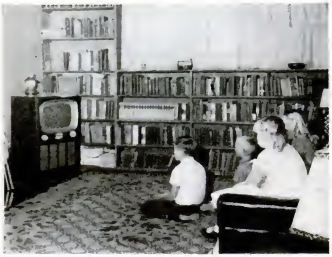
On the other hand, you may want to shoot the works on an eye-filling bay window—in modern lingo called a "bow bay." A number of firms offer multiple window units that can be assembled for



THEY GOT A BOW BAY. Dining and living rooms were too small to suit the James Scanlons of River Edge, N.J. So Jim, who works for U.S. Plywood, slipped a bow bay into the garage-door opening, raised the floor, and broke through two walls for doorways to a brand-new 12′ by 20′ dining room. The old dining room is now a part of the Scanlon living room. Materials, including luxurious Honduras-mahogany-surfaced plywood for the walls, came to around $1,800.



SIMPLEST WAY TO CLOSE A GARAGE is this easily made wall unit that the Wardells used on their California home. Lower half is standard stud construction, paneled to match the house siding. Except for one tilting window, glass is puttied directly into the rabbeted upper frame, saving the cost of sash. How the new room looks on the inside is shown in the photo below.



this purpose. They come in a wide variety of sizes and can be combined to provide practically any bow-bay width from 5′ to 21′. All are furnished with both stationary and tilting sash, hardware, summer screens, and either double-strength glass or insulating glass. Prices range from around $165 to $765, depending upon the size of the assembly and the type of glazing.

With these bow-bay units, you still must supply the footing, supporting wall section, and roof. But such an installation adds immeasurably to the appearance of your garage-conversion job, both inside and out.

Floors. Instead of laying tile on an existing concrete garage slab, you may want to build a wood floor, or subfloor for tiling, on joists above the slab. This is desirable for resilience, better insulation and, often, to maintain the floor level of the rest of the house.

Check your ceiling. Will it give you enough headroom for such a change? If not, you can still have a wood floor at the present slab level by breaking up the concrete and excavating to a depth that will provide at least a foot of air space under the new joists. You should run a ventilating duct from this into the cellar or out under the garage wall to a window well.

To support the joists, you'll need ledges of poured concrete or of concrete blocks just inside the garage's two long foundation walls. (In a two-car garage you'll need additional support down the center.) These need not go as deep as the garage-wall footings, but they should provide a broad and solid base.

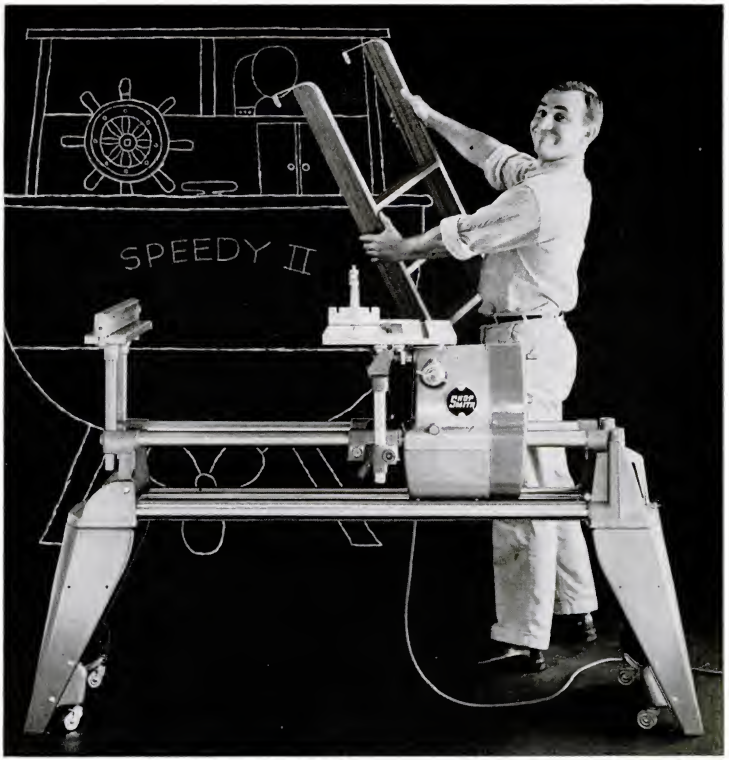
Interior walls. In warm climates, you may prefer to put only a coat of masonry paint on the inside wall surfaces. Alternatives are plywood, solid wood paneling or wallboard, nailed to furring strips attached to the blocks with cut-steel nails.

On a wood-framed garage, insulation batts should be stapled or nailed between the studs of all outside walls before applying panels or wallboard.

Ceilings. Many garage ceilings are rough-plastered. If the texture of such a ceiling satisfies you, just give it a coat of paint. Otherwise, use the present job as a scratch coat for smooth finish plastering.

Garages with exposed ceiling joists offer two possibilities. You can level the undersides of the joists with furring and apply ceiling tiles or plasterboard. Or you can recess narrow panels between the joists for an exposed-beam effect. In this case you brad the panels to furring nailed to the sides of the joists at the desired height.

Heating, lighting and plumbing. Does your present heating plant have the reserve capacity to handle the new living space? Frequently it does, particularly in a two-story house with an attached garage. If you have bedrooms above this unheated area, they may have been drawing heavily upon the furnace, in spite of garage ceiling insulation. Enclosing and insulating the garage relieves the plant of this burden so that it usually has



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sufficient capacity to heat the garage.

Wiring is not usually a problem; most garages are already wired for at least one light. Use the existing cable to get power from the house, but have the end at the fuse box reconnected as a separate circuit. Then you can add more lights and outlets in the garage without having to run a new cable.

Be sure to install all fixtures before you cover the walls with paneling. If the walls are already covered, or if you plan to leave the concrete exposed, surface raceways can be used to run power to lights and outlets. These aren't as desirable as concealed wiring, but they don't require you to tear your walls apart.

If your remodeling plans include a bathroom, lavatory, or laundry tub, check your present house layout. Can you tie into the existing water lines and waste pipe easily? More often than not you can, because a majority of garages are placed close to the kitchen. But you can save expense, even here, by spotting new fixtures as close to the kitchen wall as possible, to keep your pipe lines short.

House layout. Integrating your new living area with the old one is even more important than construction details. A garage that cannot be reached from a living room without passing through a kitchen would be ideally located for a rumpus room. But it would make a poor dining room. In the latter case, providing an independent hallway, either by shortening the kitchen or enclosing an open porch, will often solve the problem.

Worried about leaving your car outside? You shouldn't be. Today's automobiles are engineered from the paint job in to take the weather, and 60 percent of them never see the inside of a garage unless they're being serviced or repaired. But if you want to ease your conscience you can always build a car port, and still be many dollars ahead.

Your garage ties up some $11 a square foot of floor area—based on national average house-construction costs. At that price, many a family may well ask: Why share our home with an automobile?

Here's How You Can Have a Cedar Closet

HANDY PACKAGES of aromatic red-cedar paneling are available at lumberyards, tongued-and-grooved for easy installation. The cedar boards can be nailed directly over the existing wall.

PANELING IS INSTALLED by starting at floor, working up. The boards are grooved on ends, as well as sides, to provide airtight enclosure. The door must fit snugly.

JOB COSTS ABOUT $50 for a closet of average size, 3'-by-5'-by-8'. This includes the paneling, four- or six-penny nails, and cedar quarter-round molding to close off the corners. END

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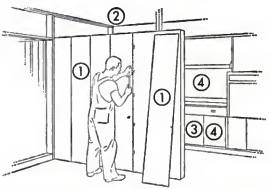

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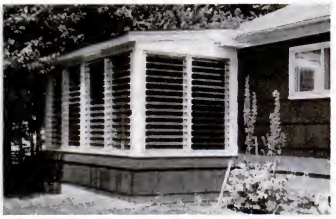
The Facts About Building an Addition

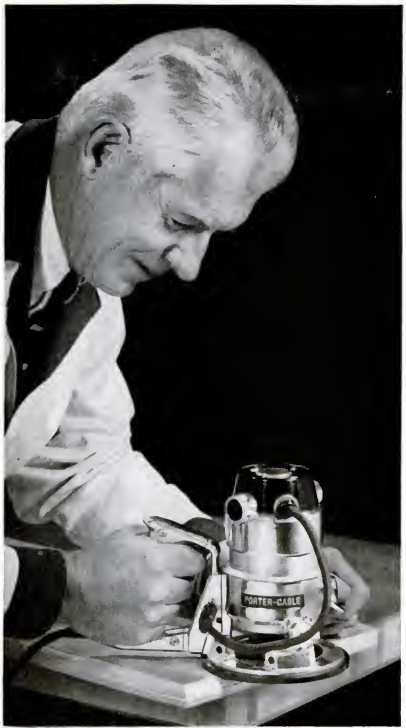
The obvious way to get more elbow room in your present home may actually be the smartest way



BUILDING an addition to your home is often the best way to increase your living space even though it may sometimes be the most expensive.

You can get exactly the kind of space you want—the size, shape and arrangement that best suits your needs. And you can get it in a way that does the most for your house—makes it bigger-looking, gives it distinction and also increases its

AN ADDITION IN THE MODERN MANNER. Mr. and Mrs. William Pond needed more space, liked the looks of a modern jalousie enclosure. They got both in this smart addition to their Norwalk, Conn., home. Posts were located to take stock-size jalousie frames, which were bought first. To permit wide spacing, four-by-fours were used instead of conventional two-by-four studs.



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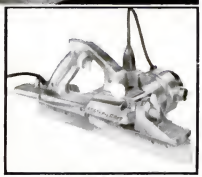

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value. What you pay will come back later.

The cost of building an addition at contractors' prices averages about $10 to $15 a square foot. This means that a 10′-by-12′ room will cost from $1,200 to $1,800.

Careful planning is very important, however, if you are to get the most for your money. Consider these points:

- The room you add need not be the room you want. If you want a bathroom, a better and more economical arrangement may be to add a bedroom and convert an existing inadequate bedroom into a bathroom. That way, you get both a bathroom and a better bedroom.
- Additions offer a chance to correct faulty floor plans. An addition may thus involve remodeling or modernizing other areas of the house and converting them to different use.
- Smart placement of an addition can save money. By using the space formed

NEW CEILING JOISTS were securely anchored to the Ponds' house by removing just enough siding to expose tops of existing wall studs. Joists were then spiked to the sides of the studs.

TRIAL FIT was made on first rafter by blocking it up until exact angle and length were found. Outer end was notched to rest flush on top of new wall, and overhang was trimmed level on the underside. Rafter was then used as pattern for cutting others all alike. Two-by-sixes, used here, handle spans up to 12′; two-by-eights are needed for longer spans.

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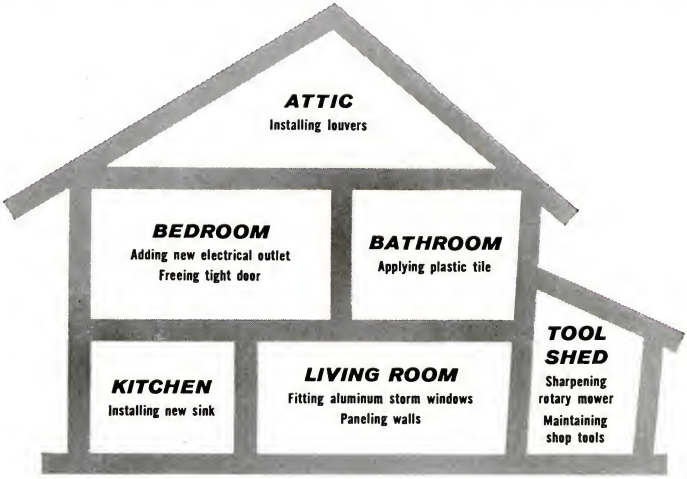

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by an L-shaped house, for example, you need only two walls to complete the enclosure. A haphazard location can cost money; don't, for example, put it where it will be inaccessible to power equipment and concrete trucks.

• Clever design of an addition can improve exterior appearance. It can make a high, boxy house long and sleek, a nondescript or look-alike house distinctive, a modest house big and impressive. Poor design may lower value, make a house hard to sell.

In planning, an architect is low-cost insurance against a botched job. Figure his charge at 10 to 12 percent of the construction cost. For partial service you may be able to get him at $10 an hour.

If you go it alone on design, stay on safe ice by keeping trim, finish, materials, roof and window lines the same as on the existing structure. Keep building lines simple.

Foundation. Having the needed excavation done with power equipment may cost $12 an hour, and take only an hour or two, but few operators will move equipment to a job for less than $50. Save by watching for equipment working nearby. Then dicker to have them stop at your place. They may waive the minimum.

Your addition will have a foundation on solid ground below the frost line. It will consist of a wall 8″ to 12″ thick, resting on a footing that's as deep as the wall is thick and twice as wide.

Power equipment will make a trench at least 2′ wide. You can then pour a concrete footing directly in the earth, or between form boards set in the trench, and on it build up a masonry wall to the height you require.

For a low wall, you can save by digging your own foundation by hand and pouring the wall and footing in one operation. Widen the trench at the bottom and build up wood forms for that part of the wall that extends above ground. Put in anchor bolts to hold the sill, if local codes require them.

If you have a concrete wall poured for you, figure its cost at $1 to $1.25 per square foot. Figure the cost of a block wall at 80 cents per square foot.

Floor. A poured-concrete slab is generally the most economical type. If you are

STRIP OF ROOF was peeled off the Ponds' house to expose rafters, then new rafters were attached with ⅜″-by-4″ bolts. Rafters can pivot temporarily on one bolt for adjustments.

The Stanley Router is a basic tool in your woodworking shop

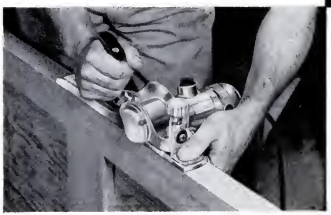
The router shown here, cutting a decorative edge, is Stanley's No. H45. Its ½ hp Stanley-built motor powers a wide variety of bits at a smooth cutting 22,000 rpm.

This router is a basic tool in your woodworking shop for two very good reasons.

1. The router does hundreds of woodworking jobs like Decorative Cuts • Tongue and Groove • Strip and Block Inlay • Mortise and Tenon • Scrolls • Hinge Mortising • Rounding Edges • Dovetails • Rabbets • Beading.

2. The router motor is the power plant for other Stanley Electric tools you can add as you need them. Attachments readily convert router to a plane or shaper, and fit it for dovetailing, grinding, beading and fluting, or hinge mortising.

H45 Router $49.50



HOW TO BUILD YOUR POWER TOOL SHOP

Buy the router and add accessories as you can. The big plane shown here is powered by the router motor . . . with the H170 Plane Kit you convert readily. Other attachments, conversion kits and a full line of Stanley "Hi-Hone" bits and cutters available when you want them.

H170 Plane Kit $44.75

Ask your dealer to show you Stanley Routers and accessories. For free Catalog 400, write Stanley Electric Tools, Division of The Stanley Works, 639 Myrtle St., New Britain, Connecticut.

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anywhere except the Deep South, include 1″ foamed-plastic insulation around the slab's perimeter. That's where the slab loses most heat. Also for a warmer slab, put your heat there—radiation pipes or warm-air ducts. In the latter case, have the ducts loop the perimeter, and run the insulation down under them.

To keep moisture from seeping through the slab into the house, first put down a sub-base of 4″ to 6″ of well-compacted coarse gravel and top it with a vapor barrier, such as sheet polyethylene plastic. Run the barrier up under the perimeter insulation and tack it to the sill.

The poured-concrete slab need be only 3⅝″ thick. Reinforce it with 6″-by-6″ welded-wire mesh. Never permit any wood to remain embedded in the slab or anything to puncture the vapor barrier. Have the slab finished off very smooth. You'll then save by being able to use the thinnest gauges of floor tile over it.

An alternate type of floor is wood construction over a crawl space. The floor will stay warmer and drier if an opening can be made into the main house foundation to heat and ventilate the crawl space. If this is impractical, insulate the floor and add vents in the foundation walls—at least two square feet of opening for every 100 square feet of crawl space. A vapor barrier laid over the earth is essential to keep out dampness.

Walls. The wall begins with a sill, usually a two-by-six or two-by-eight. It should be set in mortar to help seal the space between it and the foundation wall. If a slab is to be poured against a sill that isn't covered with a vapor barrier, staple 15-pound felt to the sill to keep it from absorbing water from the concrete.

In average construction, wall studs are two-by-fours on 16″ centers, doubled at corners. If your wall height is 8′, buy your two-by-fours in 16′ lengths and cut them in half. They'll be straighter than eight-footers. Choose the straightest ones for corner posts, plates, and door and window frames. Be certain your construction does not require special custom-fitted doors and windows. They're expensive enough in stock sizes.

Remove the exterior finish and sheathing from the house where the addition's walls meet it. Solidly nail the studs and framing of the new walls directly to the studs and framing of the existing house. Cover the walls with tongue-and-groove sheathing or sheathing-grade plywood. Tack building paper over the sheathing before you apply the finish siding.

Roof. The simplest and most economical to build is a single-pitch, or mono-slope, "shed" roof. It blends well with other roof types. Further economy: Leave the underside exposed for a beamed-ceiling effect. To prevent heat loss, put down the rigid type of insulation on top of the roof before applying the roof surface.

A double-pitch or gable roof usually requires tricky cuts and notching. Sidestep these problems by using the rafters in the existing roof as a pattern for cuts and notches.

Roofs are traditionally sheathed with ¾″ tongue-and-groove boards. Get a roof equally strong and save on labor costs by sheathing it with ⅜″ plywood. The big panels go on much faster.

The pitch of your roof—the number of inches it rises in each horizontal foot—may determine what kind of roofing you can use. You can't use slate on a pitch of less than 6″ in 12″, asphalt singles on a pitch of less than 2″ in 12″, with special cementing required under 4″ in 12″. On flat or nearly flat roofs, you can use little except roll or built-up roofing. Allow for this if you want your new roof to match the existing one.

Install flashing where your new roof meets the house, and above windows and doors. Aluminum, in most cases, is as satisfactory as copper and much less expensive. Where soldering of flashing is required, as on chimneys, choose copper. Caulk all cracks and joints so that the addition won't leak away the dollars you spend on fuel.

Exterior finish. Keep it simple. Don't think you have to make it different for "variety." The result may be a hodgepodge.

The most weather-resistant woods for exterior use are redwood, cedar and cypress, although you can use less expensive siding if you plan to paint it. Use aluminum nails and you'll never be bothered by "weeping," an occasional failing even of galvanized nails, especially in damp or rainy climates.

Insulation. Don't skimp on it. Some builders are now putting as much as 6″ between roof rafters and are packing side walls with full 3″-thick batts. The reason:

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Heavy insulation not only saves winter fuel but is a particularly critical factor in summer cooling. It costs five times as much to cool your house one degree as it does to heat it one degree. Batts with aluminum-foil facing are expensive—but pay off.

If your addition has a finish ceiling, insulate the ceiling, not the roof. Ventilate between ceiling and roof, as you would any unused attic. To secure an air wash between rafters, include small louvers or screened openings in the underside of the roof overhang.

If the addition is next to an unheated area, such as a garage, don't overlook insulating these walls. If they are closed, take off a top board and pour in pellet-type insulation.

Interior finish. Apply finish only after all plumbing, heating and wiring have been done. If your electrical circuits are already overloaded, get increased current by enlarging the size of the service entry. Typical charge for converting from a 60- to a 100-ampere service ranges from $75 to $150.

Most economical wall finish is gypsum board—five to six cents per square foot. It's good, too—so good it's going into many luxury homes. New techniques make it easier to get invisible joints. If you find your own joint technique still off, use sand- or texture-paint to hide imperfections.

Don't overlook the handsome new wall-paneling materials available. They are worth inspection at your lumber dealer. Of special note are prefinished hardwood panels in sheet and plank patterns. Price: about 50 to 80 cents per square foot. But they are beauties. END

JALOUSIE FRAMES went up in one piece on the Ponds' new addition. Glass slats were then inserted in metal clips that pivot like Venetian blinds. Frames also hold screens, storm sash.

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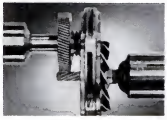
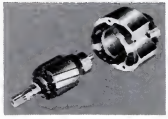
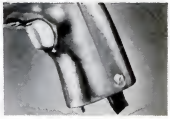


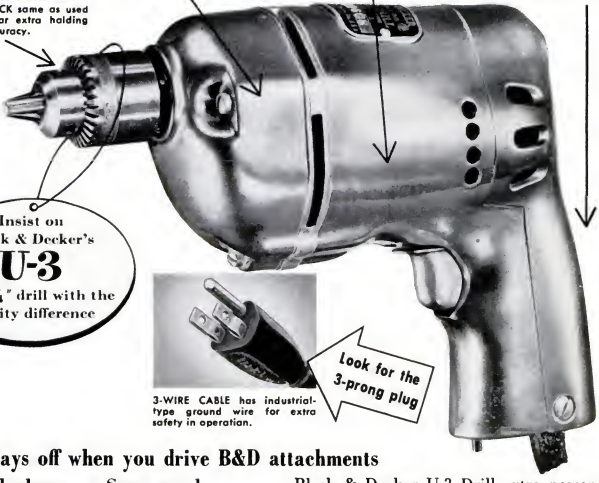
HIGH-QUALITY HELICAL GEARS give quieter, smoother flow of power from motor.



FAMOUS B&D-BUILT MOTOR has 45% more power, 100% greater torque (turning force).



SLIM, TRIM HANDLE is shaped to fit the hand for better control. Bright, highly polished housing stays new looking.



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6 Locations for That Extra Bath

NO ROOM for an extra bathroom? It's a rare home where this is really the case. A bathroom can be squeezed into an amazingly small space. An area 3′ by 5′ handles a wash basin and toilet; 3′ by 8′ is enough for a shower, too.

Look for the space in places like:

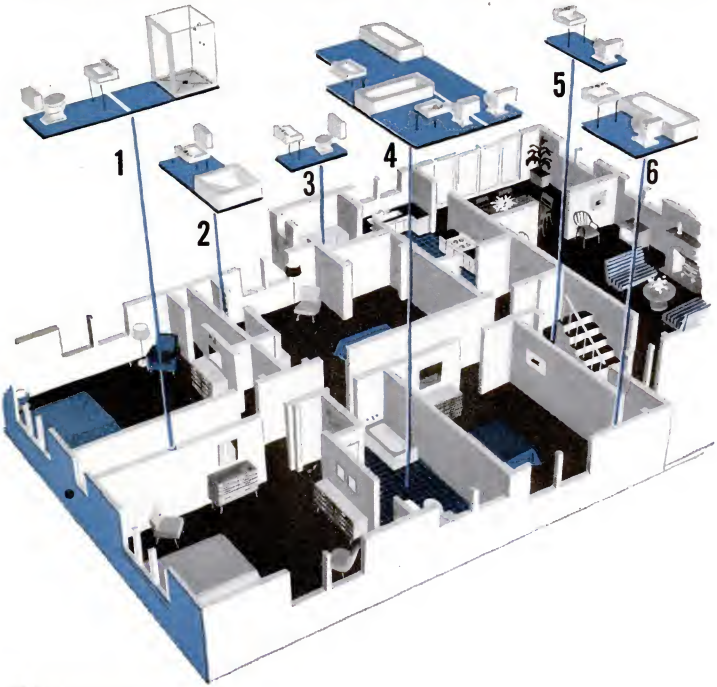
1. A hallway. The untraveled end of a hall, next to a window, may contain as much as 30 or 40 square feet—adequate space for a bathroom.

2 Closets back-to-back. Opened up, they sometimes measure as much as 4′ by 4′. A walk-in closet might become a powder room by itself.

3. A first-floor laundry. Streamline the laundry with modern appliances that take up less room, like a dryer-over-washer combination. Then add a half bath.

4. An existing bath. An average basin, bowl and bathtub need a minimum of 5′ by 6′. Some large bathrooms can be split into two by relocating the fixtures.

5. Under the stairs. A wash basin



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HUNDREDS OF USES:

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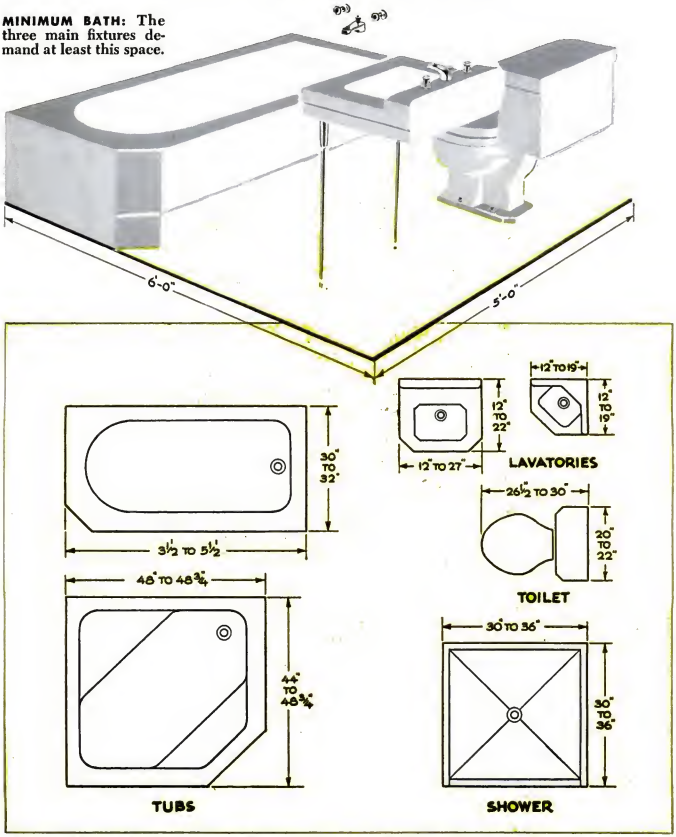
and toilet usually will fit here. Just remember to check the headroom before you go ahead with the installation.

6. Part of a bedroom. Take a 3′ slice from one side of the room. Put a toilet at one end of the new room, a stall shower at the other and a basin opposite a door in the partition.

Other tips. Have the door swing out, or install a sliding one. Ventilate windowless rooms with a ducted fan or prefabbed skylight. Place new fixtures near existing water and waste lines for a lower plumbing bill. Check floor joists: Conventional fixtures weigh up to 20 lb. per sq. ft., tile in mortar up to 30 lb. On spans over 11½′, better double 2″-by-8″ joists on 16″ centers.

MINIMUM BATH: The three main fixtures demand at least this space.



PLAN YOUR OWN BATH by using these standard fixture dimensions. Allow adequate clearance around them—3″ to 4″ of arm room on each side, at least 24″ between fixtures.

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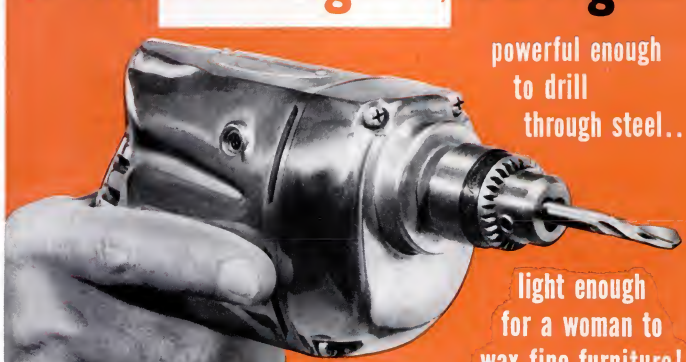

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MODEL 149B. *¼-inch drill; AC-DC 25 to 60 cycle; 115 volts; 2500 rpm. free speed; 1500 rpm. load speed; 3 lbs.; U.L. approved.*

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How to Move a Porch Indoors

A roof and foundation put you well on the way to a permanent enclosure. Add walls and the job is done

TAKE a fresh look at an open porch and you'll see that it represents the two most expensive parts of an addition to your house: a floor and a roof. You need only three walls to make it a permanent room.

Modern building materials give you a broad choice of attractive enclosures. For permanent walls, you can use conventional stud construction. The method is the same whether you fit screens in between the studs or nail up large building panels over them. Spacing isn't critical because the studs support no weight—you can locate them to match whatever materials you use.

For a winter enclosure, you may prefer an insulated wall, using standard batts that fit between studs either 16″ or 24″ apart.

Mr. and Mrs. Henry Weiman chose a modern material—aluminum—for the convertible enclosure on their home in Norwalk, Conn. Screens and louvers keep out bugs and rain in summer; glass seals out the cold in winter. Louvers, screens and glass frames are made of aluminum, following Reynolds Metal Co. plans.

Two-by-four studs were first put up to divide the sides of the Weimans' porch into equal sections. Short sections of louvers were then fitted between the studs to provide a low knee wall. The louvers, cut from sheet aluminum, can be made in widths up to 36″ and stacked to any height. Their ends are held in frames made of 1″ aluminum angle.

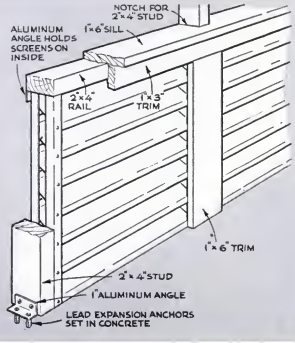
To avoid trouble later, the studs are anchored directly to the concrete with metal angles and screws. This eliminates a wood sole plate that might eventually rot from water dripping off the louvers. Flashing riveted to each bottom louver carries water off over the edge of the porch.

The tops of the studs are spiked to the porch header along the front where the roof line is straight. Along the sloping sides, a level two-by-four is run from the house wall to each corner post to provide a horizontal header, and the studs are nailed to the underside. The opening above the header is filled in with decorative boards cut to match the roof slope so that their bottom edges are horizontal.

Over each set of louvers a two-by-four rail is spiked between the studs, and a one-by-six sill board is nailed on top. Screens

ALUMINUM LOUVERS were used on the Weimans' porch to give effect of a partial wall without blocking cool breezes in summer. Sill above the louvers is sloped slightly to shed rain.

GONE ARE THE COLD, RAIN AND BUGS that made the old open porch unlivable much of the time for Mr. and Mrs. Henry Weiman of Norwalk, Conn. Closed in with interchangeable screens in summer and storm sash in winter, the porch now becomes a useful family room all year 'round.



HOW LOUVERS FIT BETWEEN STUDS is shown in drawing above. They're made by cutting sheet aluminum into slats and riveting the ends to frames of aluminum angle. At right, screens can be made to any size to fit openings above the louvers. Screens, storm sash and louvers are made from Reynolds Metals Co. plans available at hardware stores and lumberyards.

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are held in tracks on the inside of the louvers and are replaced in winter by glass. For greater warmth and protection against breakage, plywood panels could be substituted for the glass.

The screens above the louvers fit between the studs and go on from the outside, up against quarter-round molding used as stops. Identical glass panels are put in similarly in winter, and both are held in place by metal turnbuttons. Double storm sash could be installed by putting additional glass panels on from the inside, against a second set of stops.

A DETAIL WORTH NOTING: Metal angles and expansion anchors were used to fasten studs to the concrete floor of the Weimans' porch. This means there'll be no wood plate to rot.

AFTER STUDS WERE UP, a two-by-four rail was nailed between them about 30" high to form openings for the Weimans' louvers. Tops of studs butt against a level two-by-four header.

Dividing each sash into two sections, as was done on the sides of the Weiman porch, makes them easier to handle and store than the full-length ones in front. But in deciding where to divide them, care must be taken to avoid a view-obstructing line that falls at eye level when either standing or sitting.

The Weimans figure they spent about $80 for lumber and a door to enclose their 8′-by-14′ porch. Louvers cost $60. A full set of screen sections ran to about $60, and an identical set of glass sash $95. That's a year-'round room for $295.

TO GET A SNUG FIT against the shingles on the Weiman job, stud was spiked to house, then faced with a notched trim board. Drawing compass transfers outline of shingles to board.

SHIPLAP SIDING was used to fill the space between the screens and the sloping roof. The lower edges, cut to decorative scallops, hang several inches below top of the screens. END

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- In a bedroom: turn one room into two.

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Whatever your sawing requirements . . . construction, cabinet work, industrial or hobby . . . this new Clausing will give you performance surpassing anything you've ever experienced in saws of comparable size. It is the only saw to give you the important features listed below . . . the saw to consider before buying *any* saw. Get the facts and compare!

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- ★ ¾" diameter arbor
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- ★ Double-locking lift-off fence . . . best in the industry
- ★ Modified-wedge cog belt drive
- ★ Big, efficient blade controls
- ★ Large mitre gauge with keyed slide
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- ★ Cast-Iron base

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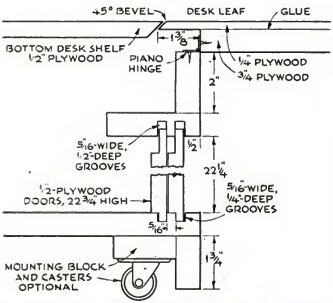
DESK LEAVES OPEN LEVEL on the Huff divider because of beveled lip, as shown in sketch below. Lip is formed by gluing extra ¼″ thickness of plywood to top of ¾″ plywood.



SLIDING DOORS are rabbeted extra deep at top so they can be removed or inserted by pushing them upward to free lower edges. Casters are concealed by skirt almost touching floor.

tion, such as a waist-high counter for serving food to an adjoining dining area. Often a set of vertical poles will give the effect of a divider without closing off light and air. You can make brackets to hold the poles by drilling matching holes in wood strips and fastening the strips to the floor and ceiling.

A divider is also an ideal spot to mount a TV set on a swivel. Then you can let part of the family watch while others want to talk in another area.

By building your divider as a storage unit, you can gain an entire wall of shelf and cabinet space while stealing only a foot or so of floor space. A divider can also add a decorative touch. Plants, fish tanks and light fixtures have all been used to dress them up.

Where only partial privacy is needed, run the divider 1′ or 2′ short of the ceiling. The open space at the top will keep the new smaller areas from looking closed-in. For complete privacy, you may prefer a full floor-to-ceiling unit.

Two bedrooms from one. One couple with two children in the same bedroom used a double-decker bunk bed—itself a space saver—to create two separate bedrooms. They nailed a plywood panel to one side of the bed between the floor and the upper bunk. Then, on the opposite side, they nailed another plywood panel between the upper bunk and the ceiling.

A door hinged at the end of the bed completed the new "wall." Now the youngsters share a single bed—but in different rooms. Reconverting to one room later will be simple.

Wheeled dividers go anywhere. Darrell Huff of Sonoma, Calif., built a portable storage wall mounted on casters. Already it has served to divide one big office into two, a garage into a workshop and den, and his two daughters' bedroom into separate sleeping areas.

The sides, shelves and uprights in the divider are all 16″-wide strips of plywood (three widths sliced from each 4′-by-8′ plywood panel). Hinged desk leaves drop down on each side, and sliding-door cabinets are arranged so that half open from one side, half from the other.

The Huff divider leaves an open space at the ceiling. When a fully closed partition is wanted, he just fits in small pieces of plywood at the top and hinges a door at one end of the divider. END

Ideas You Can Borrow from House Trailers

Space savers designed for mobile living will solve many small-house problems, too

YOUR home may seem like cramped quarters, but many trailer families squeeze into a space from a half to a quarter as big. Less than 400 square feet of floor area may give them three separate bedrooms, a living room, kitchen-dining room, and full bath. Ingenious furnishings do the trick—sliding doors, folding walls, shallow floor-to-ceiling cabinets, foldaways, pull-outs, and dual-purpose furniture.

While some of these trailer features involve more inconvenience than the average homeowner would put up with, you can profit by borrowing other ideas, to make the most of your own house space.

PULL-OUT TABLE that operates on the principle of a roll-top desk is the biggest space saver in this trailer kitchen. You'd find one like it just as handy to "enlarge" a cramped dinette.

FOLDAWAYS are as old as ships' cabins, but trailer manufacturers make the most of them. A table, work shelf, vanity, bunk or lavatory hinged to a wall takes little or no floor space when not in use. Similar foldaways will go far to solve your own space problems. [CONTINUED]

Trailer tricks make space do double duty. Try some at home

WORK-COUNTER SPACE is increased when removable covers are fitted to both sink and stove. The sink hatch shown above comes in two sections that rest on a ledge. For the stove, a metal-bottomed lid hinges down from the wall to safely cover the burners and the pilot light.

DUAL-PURPOSE FURNITURE for trailers includes sofas that convert into double beds, and facing dinette seats that make up, sleeping-car fashion, into beds at night. Storage space may be cabinets placed high enough for head clearance, or spacious seat boxes with cushion tops. END

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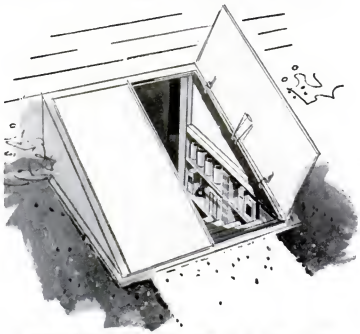
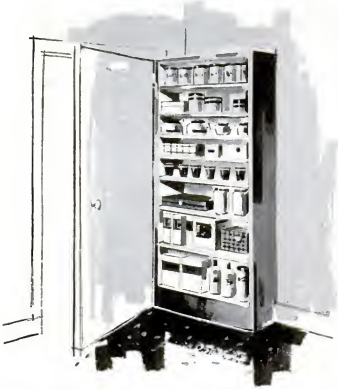
4 Space-Making Ideas for Your Home

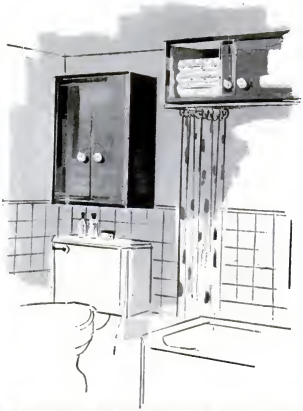
1 ON A WALL ABOVE A SOFA, usually bare, hang one or more wood shelves on brackets attached to the studs. You'll save the floor space that a full-length bookcase would take up.



2 BUILD SHELVES in the sides of a cellar-door hatchway, cutting back some earth if necessary. Paints, turps, lawn chemicals and similar supplies are safer outdoors than in.



3 A KITCHEN DOOR often swings to within 3" of a blank wall—the amount the knob projects. Steal an extra inch—so that the door doesn't quite swing back all the way—and build easy-to-reach ceiling-high pantry shelves 4" deep to hold canned foods. Arrange the shelves so that the knob fits into a space between.

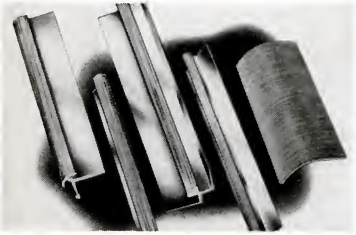


4 BATHROOM SPACE IS WASTED above fixtures and at the top of tubs and shower stalls. Cabinets attached to the wall and ceiling will hold towels, linens and other supplies. Ceiling cabinets can often be installed in other areas, such as over doorways and in corners, without being in the way or obstructing headroom.

BRIGHTEN ANY ROOM with luxurious Weldwood Paneling. This cheerful birch V-plank paneling gives a random-plank effect, yet comes in 4′ x 8′ sheets that are prefinished to save you hours of labor . . . and costs only $65 for a full 12′ x 8′ wall.

Make an old room new again with easy-to-install Weldwood paneling

INSTALL PANELS with nails concealed in V-grooves, or with Weldwood Contact Cement, on furring strips over studs, or over old walls. Bonds permanently, on contact, without clamps.



EMPHASIZE JOINTS with Weldwood Veneer-Faced Aluminum Moldings to match panel wood. Also available: Weldwood Hardwood Trim, in a variety of woods and styles.

You can enrich a room with wood paneling easily and less expensively than you may think.

Weldwood Prefinished Paneling comes in a handsome variety of woods and finishes, all ready to install. Each panel is factory sanded, waxed, and rubbed like fine furniture to bring out the true wood beauty and protect its surface. Or, you may buy Weldwood Paneling unfinished at lower cost.

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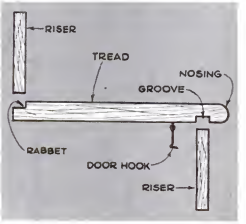
Removable Steps Solve Space Problem

STRAIGHTAWAY ACCESS is a must for moving bulky objects up and down narrow stairs. The Ron Andersons got it in an ingenious way after finding they couldn't heft furniture past a right-angle turn at the foot of a stairway in their Minneapolis home. They installed treads and risers that hook to the side runners for easy removal. It's then possible to convert the stair well into an open hatchway, reached (as seen above) from an aligned back door and cellar stairs. Foam-rubber strips on the runners damp tread sound.

SCREEN-DOOR HOOKS attach the stair members firmly to side runners. The runners are extra thick (1½") to provide good bearing surfaces. Foam-rubber strips offer locking tension for the hooks.

RABBET AT REAR and groove under the forward end of each 1"-thick oak tread act as interlocks for risers. As shown in the photo at left, the topmost riser is permanently attached to the side runners.



It's easy to build a sound-conditioned game room like this!

Here's a game room where the kids (and you) can raise a rumpus without rousing the whole house and neighborhood. And you can build a room like this in your basement for much less than you might think.

Gold Bond Acoustamatic Ceiling Tiles can be stapled—or nailed—easily to wood furring strips applied right on your old ceiling. Both random and regular patterns (see above) have hundreds of perforations that soak up noise. You have a quiet room, and the ivory-white, flame-resistant finish makes the room bright and cheery.

The attractive walls are of Gold Bond Gypsum Wallboard and Insulation Tiles. Tiles come in ivory-white and a random assortment of four lovely pastels. Interlocking edges hide nails or staples. Wallboard goes up fast. Saw panels like wood, or score with a knife, and snap. Finish with quick-drying Gold Bond Velvet Latex Paint and matching Latex Enamel. Move in!

Want plans so you can start building? Write for free illustrated folder, "How to Remodel Your Basement," to National Gypsum Company, Dept. PS 97, Box 73, Buffalo 13, N. Y. Then see your local Gold Bond® Dealer. He'll supply everything you need — including helpful advice.

Gold Bond
BUILDING PRODUCTS

NATIONAL GYPSUM COMPANY

OPERATION HOME IMPROVEMENT
Better Your Home

Scrap Forms Speaker Grille

ATTRACTIVE grille trim for a homemade speaker enclosure may be no farther away than your scrap bin and your wife's "junk jewelry" box. Umbrella ribs, or metal binding strips from calendars can be woven into many patterns. Solder rosettes at intersections, if you like; then gild.—*Carlton G. Bucher, White Plains, N.Y.*

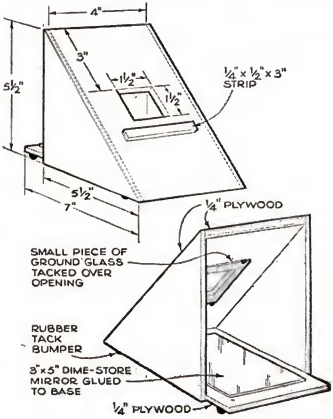
Radiator Hose Patches Pipe

YOU don't have to own a pipe threader to replace a short length of leaking water pipe at a distance from a union. Cut out the defective section with a hacksaw and make a coupling from radiator hose, as shown above. Such hose comes in sizes to fit most home water pipes, and if slightly oversize it can be drawn tight when you fasten the hose clamps. A hose coupling is also handy on horizontal drain pipes that have to be parted periodically for cleaning.—*Louis M. Reitz, Bourbon, Mo.*

Mirror Lights Up Color Slides

THE viewer below will give you a quick look at your 35-mm. color slides when you don't have the time or opportunity to set up a projector. It needs no batteries or light bulb, yet produces a surprisingly bright image that several persons can see at one time.

The secret is a small dime-store mirror. Cemented to the base, it reflects light from a window or a table lamp up through a piece of ground glass to illuminate the transparency. You can make the sides and base from ¼" plywood or other light wood. For 2"-by-2" slides, make the center hole and ground glass correspondingly larger. The ground glass is available in precut sizes from photo-supply stores.—*Eric R. Adams, Toronto, Ont.*



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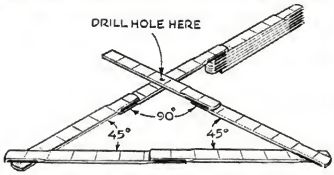
Folding Rule Is 7 Bonus Tools

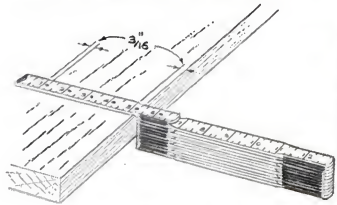
A SIX-FOOT folding rule will do a lot more than just measure distances. You can use it as a vertical level, a try square, miter gauge, marking gauge, compass, protractor and template. To make it serve all these purposes, extend the first blade of the rule. Butting the rest of the rule against the edge of a board (see lower sketch, opposite page), note the distance between this edge and the 5″ mark (on my rule it is $\frac{3}{16}$″). At exactly this distance beyond the 1″ mark, bore a $\frac{3}{32}$″-diameter hole through the rule at its center line. Continue boring holes at 1″ intervals the full length of the rule. Also open it at the 12″ and 24″ joints to form an accurate 45° right triangle. Bore aligned holes through the two blades that cross at 90° (see upper sketch, opposite page). The photos show how the rule is then put to use as seven bonus tools. —*Philip E. McCafferty*

VERTICAL LEVEL: Extend the rule about halfway and suspend it from a nail at the 1″ hole. Hanging free, the heavy folded section holds the rule plumb for vertical aligning.



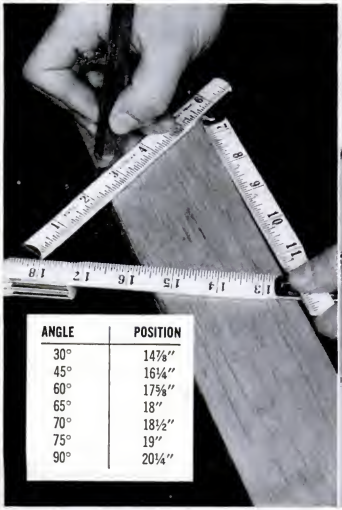
TRY SQUARE AND MITER GAUGE: Open the rule at the 12″ and 24″ joints, form a 45° right triangle, and drill aligned holes through the centers of the crossing blades. This gives you a try square or miter gauge at a moment's notice. Just slip a nail through the holes and use whichever side of the rule provides a blade that can be butted against the stock.

MARKING GAUGE: Holes drilled at 1″ intervals make the rule a handy marking gauge. Using the same method, you can transfer irregular outlines to the surface of any material.



Please turn the page for more bonus uses for your rule

COMPASS: With a nail for a pivot, the rule is turned into a king-size compass that lets you draw circles with diameters ranging from 2′ to nearly 12′. Deduct 1″ when you read the radius.



ANGLE	POSITION
30°	14⅞″
45°	16¼″
60°	17⅝″
65°	18″
70°	18½″
75°	19″
90°	20¼″

PROTRACTOR: You can lay out common angles with a triangle formed by the first three blades of the rule. Keep a chart of the angles made by various rule-tip positions, as shown.

TEMPLATE: Shaping and pinning the blades of the rule with a nail, you can duplicate an angle for transfer to material that must be cut to cover or fill a triangular area. END

WHITE CLAD MEZURALL
Ideal for the hand craftsman. Snow white line double graduated with feet and inches, and consecutive inches. ½" wide line in 6, 8, 10 and 12 ft. lengths. 6 ft. only 98c.

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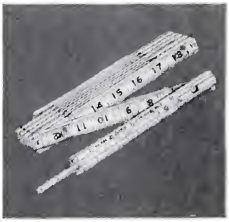

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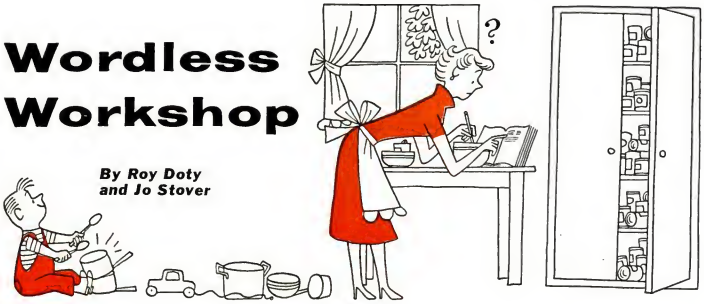
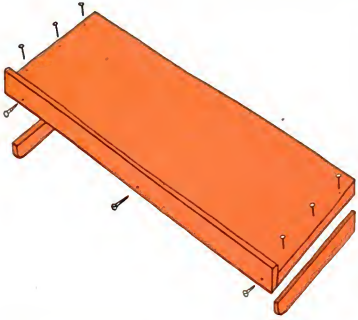
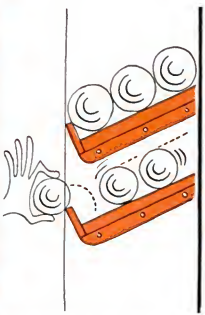
THE LUFKIN RULE COMPANY, Saginaw, Michigan

Wordless Workshop

By Roy Doty and Jo Stover





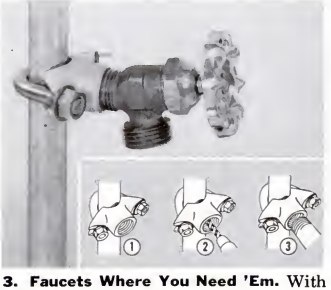


Next Month: Tracks to help guide a car in and out of a garage

New for the Handyman

1. Floor Tiles Resist Weather. Said to be the first floor tiles to withstand the effects of the outdoors, these synthetic-rubber patio tiles have many uses. You can use them as settings for barbecues and grills, garden paths, even garage approaches. Because a special adhesive is necessary and the base must be specially prepared, the maker recommends that you have the job done by a professional tile setter. Indoors, you can install the units yourself as you would any floor tile.

2. Counter Topping Is Flexible. Because it's so flexible, you can easily install this vinyl-plastic material on counter tops and in drawers. The manufacturer says anyone familiar with tools can install a de luxe kitchen counter top in a day or less. The material can be run across the counter and up the wall or counter backboard in one piece, producing a curved corner that's easy to clean. It is said to cut dish clatter and reduce breakage.



3. Faucets Where You Need 'Em. With only a drill you can connect this clamp-on pipe tee to an existing water pipe. No pipe-fitting experience is needed to install a shower, a utility faucet or an automatic washer. You do the job in three steps: (1) shut off the water and clamp the saddle tee to the pipe in the desired location; (2) drill a hole in the pipe, using the tee as a drill guide; (3) screw the new outlet or faucet into the tee.

For more handyman news, turn to page 226

NEW! MILLERS FALLS Router-Plane-Shaper

WITH REVOLUTIONARY NEW LINE OF LOW-COST ROUTER BITS

Built for professional performance

3 TOOLS IN 1

Imagine! — an exciting new 3-tools-in-1 combination loaded with exclusive features to give professional results — yet priced to bring the adventure of fine cabinet-work within reach of everyone! It's a Router, a Plane, a Shaper! — that will do hundreds of jobs quicker and better—including dado cuts, moldings, fluting, rabbet cuts, dovetail joints, inlaying, planing and shaping. A real precision tool with plenty of power and speed, that anyone can use!

Plus . . . a revolutionary new line of 17 popular Router Bits, made of Special M-2 High Speed Steel — faster, longer-lasting — at 1/3 less cost than other types.

See and buy the Millers Falls Router-Plane-Shaper and its complete line of attachments at your favorite dealer's . . . or write us for name of qualified dealer nearest you.

CHECK THESE IMPORTANT FEATURES

POWER UNIT ✓ Rugged 3 amp. motor ✓ Ball bearings throughout ✓ 30,000 R.P.M. for smoother, faster, cleaner cutting

ROUTER ✓ Large 6" dia. base and big hardwood handles for positive control ✓ Direct-reading scale for fine depth adjustment ✓ Exclusive micrometer-screw adjustment for control of cut location ✓ Extra long rods for long reach cuts ✓ Base and non-marking sub-base take all popular templet guides

PLANE ✓ Big 14" shoe ✓ Outboard arbor support ✓ Micrometer-screw adjustment for front-to-rear shoe and cutter alignment ✓ Direct-reading depth adjusting scale ✓ Notched quadrant for quick bevel cuts (—15° to +45°)

SHAPER ✓ 1/3 cost of comparable models ✓ Big work surface (24" x 7½") ✓ Built-in motor mount for quick, easy changeovers ✓ Accurate depth adjustment ✓ Adjustable fence ✓ Rugged 1" marine plywood table

Plus . . . a special "package" of exclusive *firsts* for plastic laminate application!

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Folders and full information about the Router-Plane-Shaper and other fine Millers Falls Tools . . . or write

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FINEST HAND AND POWER TOOLS MADE FOR HOME AND INDUSTRY

4. Do-It-Yourself Bathtub. Molded of glass fiber, this new tub is so light (18 pounds) that you can install it single-handed. Complete installation instructions and a matching front panel (not shown in photo) are furnished with each tub, making it easy for you to put in that extra bath or replace an old-fashioned tub. The tub looks like porcelain, yet it is said not to chip or craze under blows that would damage a conventional tub. You have a choice of molded-in colors.

5. Insulation Forms in Wall. Some day soon, when you want to insulate the walls of an existing house, you may cut a hole through the siding and pour in a phenolic resin and acid catalyst. The liquid resin will then foam to 200 times its original volume, filling the space between the studs with foam insulation. The photos at the left show how the technique was demonstrated in a laboratory setup. The near picture reveals the foam blanket after the retaining structure had been pulled away. It is expected that builders may use the process because foamed-in-place insulation will save storage space and decrease shipping loads.

More information *about handyman products can be obtained from: 1. Robbins Floor Products, Inc., Tuscumbia, Ala.; 2. Armstrong Cork Co., Lancaster, Pa.; 3. Sall Bros. Co., Rockford, Ill.; 4. Sterling Precision Corp., 1302 Expressway Drive, Toledo 8; Bakelite Co., Division of Union Carbide Corp., 260 Madison Ave., New York City 16.*

How many of these projects are you planning for your home?

- ☐ Installing ceiling tile
- ☐ Reupholstering
- ☐ Building furniture
- ☐ Installing insulation
- ☐ Making picture frames
- ☐ Making or repairing screens
- ☐ Installing low-voltage wiring
- ☐ Installing built-in speakers
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- ☐ Installing flashing paper
- ☐ Laying underfelt for roofing
- ☐ Installing vapor barriers

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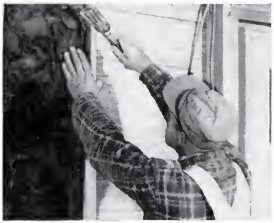

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How to Keep House Drains Open

When water won't flow, or just gurgles from a sink, these do-it-yourself tips may save you a plumbing bill

By Ralph Treves

IT'S reasonable to expect that when you pull the stopper the water will run down the drain. But sometimes this doesn't happen, or the water dribbles away in an exasperating trickle.

What's wrong? Most likely the trouble is right at the sink—or in the trap just below it, where paper, hair, lint or grease may be blocking the soil line.

The trap, incidentally, is not there for the purpose of trapping this foreign material. A trap has a completely different and important function: Its gooseneck "U" shape holds water to prevent noxious sewer gas from coming into your home.

When water merely seeps out of your kitchen or bathroom sink, first check the stopper or strainer at the top and clean out any lint or hair that may be present. If all seems clear at the top, open the trap cleanout underneath by removing the plug with a monkey wrench (there's water in the trap, so place a pan or pail underneath before you loosen the plug). Pull out any lint, hair, sand, grit or other matter with a short stiff wire.

But if these actions fail, what then? Any one of several conditions are possible and each must be checked until the trouble is located and corrected.

Grease is the bugaboo in the case of kitchen drains, which frequently become clogged by an accumulation in the lines near a 90-degree bend. The sharp turn in the pipes slows the flow of water; grease hitting the colder pipe tends to congeal at that point. (That is one reason why soil pipes should be connected with "Y" fittings at a specified slope so the waste water flows out evenly, and there is no turn to block waste matter.)

Sometimes this fitting, which could be the location of your trouble, is too far from the nearest trap that would permit entry of a cleanout auger or snake. In that case, it will be necessary to drill a hole in the pipe and tap the hole for a threaded plug so it can be closed after the line is cleaned out.

Push a springy coiled-wire pipe auger into the cleanout hole to break up soil accumulation. The auger wire at the free end is bent into a hook shape so it will cut into hard grease, which will then be washed down with the flow of water.

There are other ways to cope with kitchen-sink grease. One of the best is to pour boiling water down the drain, either as a routine every day or just after washing the dishes.

For toilet stoppage, the rubber force cup almost always does the job. Make certain there is some water in the bowl, work the plunger up and down for both suction and pressure action. If this fails, a screw-type coil auger may be used.

These are examples of common, everyday drainage problems that crop up in every home. But sometimes there is a more acute condition, as when the entire sewage line is blocked.

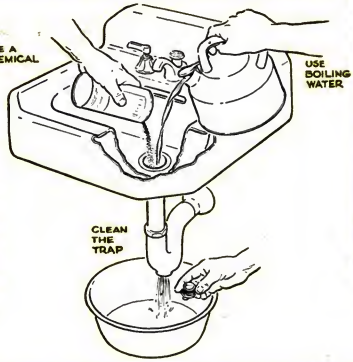
Usually this is solved by opening the

Before calling the plumber, refer to this guide sheet and you may be able to open a clogged drain yourself. This fact sheet is one of a monthly series devoted to home repairs now appearing in POPULAR SCIENCE. Each sheet is designed for keeping in a loose-leaf binder.

Next Month: House gutters.

Popular Science Fix-It File

How to avoid drain stoppage



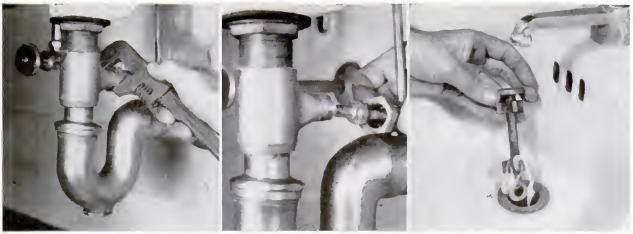
PREVENT TROUBLE by (1) pouring boiling water into the kitchen sink after washing dishes to keep grease from congealing in the pipes; (2) using caustic chemical regularly to clear out congealed fats (it's usually best to restrict chemicals to city sewage systems); (3) cleaning out lint, hair, sand and other matter from accessible traps. When stoppages occur, try one or all of these measures before resorting to the tools and more difficult methods shown below and on the reverse page.

For stoppages, try one of these clean-out tools

A FORCE CUP AND FLEXIBLE SNAKE are tools that will find frequent use in any home. Hold cup (also known as a "plumber's friend") over waste outlet and pump it up and down until stoppage is cleared. For a sink or lavatory drain, partly fill the basin with water first. A flexible snake can be thrust into sink or lavatory trap openings.

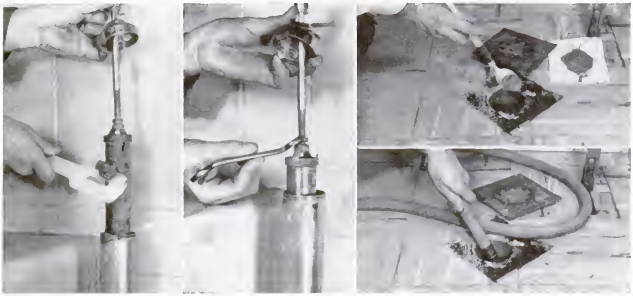
OTHER TOOLS you might use are a simple coil-spring type of snake and the more professional auger. On a toilet, apply the auger with caution to avoid chipping the porcelain inside the trap, feeding the auger coil slowly. When a drain trap has been opened, be sure to replace the gasket (see center photo) when you are putting back the plug.

How to clean a lavatory stopper



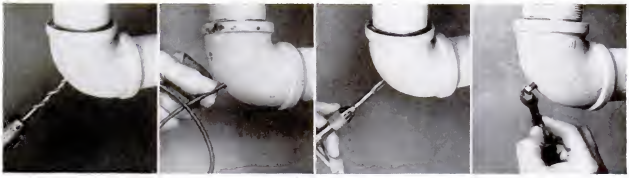
REMOVAL OF A LAVATORY STOPPER for cleaning may be done either by turning it out from above or, as seen here, by loosening a nut on the lift-rod coupling under the basin. Then pull the rod back (center) so that retainer ball is clear of fitting. This permits you to release the catch on the stopper and lift the latter out of the bowl. After clearing off entangled lint and other debris, replace parts in the original order.

How to clean a tub outlet and floor drain



FOR FAST DRAINAGE you should do both jobs occasionally. On tub outlet like one shown, loosen cap at top of tube, pull out stopper and scrape off slime and other matter. An adjustment nut (center) holds stopper at right height for quick drainage. An old spoon taped to a dowel handle can be used to scoop sand from a floor drain. Then flush drain with garden hose. Trap must always have some water to seal out noxious sewer gas.

How to clean out a soil line



IF SNAKE DOESN'T REACH trouble spot, drill a hole in an elbow and use an auger in both directions to push out blocking waste. Thread hole for a hex-head brass plug and coat threads with petroleum jelly. Hole can then be opened again when necessary.

cleanout trap which you'll find near the point where the soil line goes out from the house. The trap may be clogged with sand or other matter. Plug caps on the cleanout usually are thin brass shells. If the plug is frozen in, it must be torn apart for removal. Use a sharp chisel to make a hole in the lead cap, then pry upward to remove the entire top. The thin threaded part against the trap sides then can be folded towards the center by hammering until free of the threads, and removed.

When replacing a cleanout plug, use one that is either brass, or that has a cast-iron center with tapered lead threads molded on the outside. If the brass cap is used, coat the threads with petroleum jelly before turning it in.

One caution in this situation: The new cap must be replaced tightly, with threads correctly aligned so it is airtight to keep out sewer gas. Be careful also not to crack the cast-iron trap or cleanout.

The outside storm drain is another frequent cause of difficulty. This usually is in a concrete floor (at the foot of cellar stairs, in front of or inside the garage, in walks at the side of the house). The floor drains tend to accumulate sand which does not wash down. Easiest way to cope with this is to clean the drains periodically, using a spoon attached to a long handle such as a length of ½" dowel.

If the drains seem free but the flow is still sluggish, the trouble most likely is that the soil line leading to the sewer or cesspool is clogged with tree roots. This may be due to a weakness in the kind of soil pipe—certain species of trees spread roots to any available water and are able to penetrate many soil-pipe joints.

Rotary soil-pipe cleaners, used by professionals, help solve this problem temporarily, but if the trouble persists, replacement of the pipes may be necessary.

Quite rare is the condition where soil pipes were not properly installed, and create chronic blockups—because of incorrect pitch in the soil line. Nothing but replacement will do.

Pour water into cellar floor drains at least once a month to keep the U trap sealed against sewer gas. Other traps, because of constant use, always have water at correct level. But little-used floor drains tend to dry up. END

7 Money-Saving Plumbing Tips

1. Open and close all shutoff valves once or twice each year. Then, when needed, they won't be "frozen."

2. Drain the water heater twice a year or more to remove any sludge or rust accumulation. This settles to the bottom of the tank just above the burner and cuts down efficiency.

3. Don't put garbage down drains. You can start an argument among plumbers by asking if you should put coffee grounds down the kitchen sink. Some say it helps cut the grease; others maintain that it plugs the drain line. The safe thing is not to put anything down the drain line you don't need to.

4. Before calling a plumber, examine the item to be repaired. If a brand name or type of fixture is marked on it, write it down. Give a description of piping if you are reporting a leak—whether copper or galvanized-iron pipe—its size and location. Specific information will help the plumber bring everything needed for the repair—on the first trip.

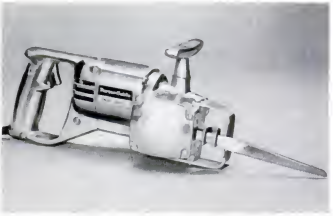
5. Before cold weather strikes, close the stop and drain valves in the house (houses in cold-weather areas have them) on each line going to an outside faucet, with the exception of special frostproof lawn faucets. Open the outside faucets and also the small drain cock on the stop and drain. This will remove all water in the section of piping likely to freeze.

6. Do not pour hot water in the toilet bowl—it may crack.

7. Inspect the flame of the water-heater burner. If it is red or orange (not predominantly blue), it needs adjusting. It's not giving as much heat as it could, and it forms carbon on the bottom of the tank, which slows down heating of the water. Some of the carbon drops into, and clogs, burner outlets.—*Loyd Weaver, Phoenix, Ariz.*

New Tools

1. Tool Shears Bolts Clean. Need a shorter bolt or machine screw? You can make short ones from long ones by shearing them with this tool. Threaded shearing holes in five sizes—4-40, 6-32, 8-32, 10-32 and 10-24—cut the bolts without damaging the threads, and they are automatically deburred upon removal. Other features, not new to the tool, are slotted jaws for crimping solderless terminals, a section for cutting wire, and six slots for stripping insulated stripping insulated wire.



2. Power Saw Has Orbital Motion. The teeth of this fast-cutting saw touch the work only on the cutting stroke. On the return stroke the blade lifts away. With a choice of eight blades available, you can cut a wide range of materials including hardwood, ferrous and nonferrous metals, asphalt, plaster, asbestos, hard rubber and plastics. The blade is located close to one side of the saw, permitting close cuts in corners. It starts inside cuts without the need for drilling holes.

3. Lightweight Pipe Wrench. This forged-aluminum pipe wrench weighs less than half as much as a comparable steel or iron tool. Only the adjusting nut and replaceable insert jaws are steel. For work in hazardous locations, the maker supplies non-sparking beryllium-copper insert jaws. The aluminum wrenches come in five sizes—10″, 14″, 18″, 24″ and 36″.

4. Screwdriver Grips Screws. You can remove screws from hard-to-reach places as well as install them with this locking screwdriver. The spring-loaded center section of the blade is cocked by twisting the knurled end. When the blade is inserted in the screw, a twist of the handle triggers the spring and locks the blade in the slot. A reverse twist releases it.

More information *about the products shown on this page can be obtained from: 1. Vaco Products Co., 317 E. Ontario St., Chicago 11; 2. Porter-Cable Machine Co., 753 James St., Syracuse, N. Y.; 3. Toledo Pipe Threading Machine Co., 1445 Summit St., Toledo 4; 4. Rinck McIlwaine Inc., 16 Hudson St., NYC 13.*

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Gus Referees a

In the livestock show at the county fair, no holds were barred—but Gus hoped to keep the mayhem down

By Martin Bunn

THE opening day of the annual county fair was always a hectic one for Gus Wilson and Stan Hicks in the Model Garage. The town's merchants were busy arranging booths to display their products. Farmers and ranchers brought in their prize livestock and produce, their wives and daughters entering their choicest cookery. Competition was keen for the various blue ribbons and other awards of merit. On this day the county really hummed.

The day started off badly for the Model Garage. The telephone was ringing when Gus opened for business at eight o'clock. A customer had wrecked his car 20 miles up the highway and needed a tow truck. Not wanting to leave the garage for any length of time, Gus sent his helper, Stan Hicks, to bring in the wreck. Stan had just pulled out when Barney Overholtz, the newspaper route boy, drove up to the pumps.

"George Fraser wants you to come out on the Big Hill road right away," Barney told Gus. "He thinks that Mike Treadway has jimmied his truck in some way, so that he can't enter his prize bull in the livestock show. He seemed awfully excited about it."

Gus chuckled. "Treadway and Fraser are always excited on opening day of the county fair. Since Stan's away with the tow truck, I can't leave the garage—that is, unless you'd be willing to handle the pumps while I'm gone."

"Sure thing," Barney said. "My newspapers are all delivered."

WITH Barney taking care of the Model Garage, Gus tossed his tool kit into his light service car and headed out on the Big Hill road. He came upon Fraser's stalled one-ton truck on a steep grade on the far side of Big Hill. It was considerably overloaded with the largest, shiniest-coated Holstein bull that Gus had ever seen, together with a Poland China boar and sow, some enormous pumpkins and squashes, and other products of the field. George, his comely wife and their pretty, teen-age daughter, Sally, were peering anxiously beneath the truck, to the accompaniment of assorted bull bellows and pig protests.

"Morning, folks," Gus greeted them, as he pulled

"It had better run now," Fraser said, "or I'll go over to Treadway's place and wring his neck."

Bull Fight

up and got out his heavy tool kit. "What seems to be the trouble?"

"The motor runs," Fraser said worriedly, glancing at his watch, "but the rig won't turn a wheel. It's eight-thirty now and the deadline for entering stock in the livestock show at the county fair is 10 o'clock sharp. This bull of mine is going to take the blue ribbon this year, for sure, if I can get him there in time."

"And," Mrs. Fraser declared, "my upside-down cake has a mighty good chance of winning first place in the cake-baking contest."

Sally Fraser turned her big eyes on Gus. "Just wait until Freddy Treadway sees me walk off with the blue ribbon for homemade bread. He'll sit up and take notice then."

"With those eyes, Sally," Gus said, "you don't need to know how to cook. Start her up, Fraser. We'll see how she acts."

Fraser started the motor and put the truck in gear, but the vehicle didn't move.

"Probably a broken axle," Gus said, "but it could be anywhere in the drive line. Shut off the motor and I'll see."

WITH the motor stopped, but the truck left in gear, Gus jacked up one rear wheel. He turned it by hand, let it down and jacked up the other. Finding that he could rotate both wheels without turning over the motor, and doubting that the vehicle would have *two* broken axles, he dismissed broken axles from his mind to turn his attention elsewhere.

"It just might be a stripped differential," he said. "Start her up and try it in gear again, Fraser, while I check underneath."

Fraser was running the motor in gear, with Gus underneath with his hand on the torque tube containing the drive shaft, when Mike Treadway pulled alongside in a three-quarter-ton pickup truck. It contained, as far as Gus could make out, a bull that was a mate to Fraser's. Treadway, a long, lean, cadaverous man, thrust his craggy features out the pickup window and spat in the road.

"Having trouble, George?" he inquired.

"Trouble!" Fraser exclaimed. He shut off the motor to get down and move over to Treadway with his thumbs hooked belligerently in the bib of his overalls. "It seems to me, Treadway, that I hired your sprout, Freddy, to grease this truck only yesterday. The rig was in good shape then. You don't suppose, Treadway, that the fact that my bull is due to beat yours at the fair has anything to do with my truck's rear end being ripped out now?"

"Your bull beat mine!" Treadway cried, peering at Fraser's animal curiously, as though he'd never seen it before. "Now, you wouldn't be planning to enter an animal like that in the fair, would you, George?"

"You know I am," Fraser retorted. "In fact, you've been leaning over my fence, ogling the critter all summer, Treadway, trying to figure out some way to beat him. If Gus finds a handful of your old bolts and nuts in my differential, I'll come looking for you."

LOOKING up at young Freddy Treadway, who sat beside his father, Sally Fraser protested, "Pa, Freddy wouldn't do that. He wouldn't do anything to hurt me."

"Hurt *you*!" Fraser grumbled. "It's my bull that's hurt, not you. With my truck shot, how am I going to get the bull to the fair in time?"

"And then," Mrs. Fraser said, "there's my upside-down cake."

"Upside-down cake!" Mrs. Treadway exclaimed. "My goodness, Sarah, are you going to enter an upside-down cake, too?"

"Since Mrs. Treadway could hardly have put bolts in my differential," Fraser said drily, "let's forget the cakes, shall we?"

"I didn't put anything in your differential but grease," Freddy Treadway protested.

"Maybe your grease isn't any better than your bull, George," Treadway said, grinning. "Well, we'll be getting on. I wouldn't want to be too late to enter the best bull in the county."

Treadway drove off, leaving Fraser standing in a cloud of dust, muttering threats.

GUS thrust his head out from beneath the truck. "The rear end isn't torn out, Fraser. I had my hand on the drive-shaft torque tube when you ran the rig in gear. If the drive shaft had been turning inside the torque tube I'd have felt the vibration. It wasn't turning, so I know that your trouble is ahead of the drive

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shaft, either in the universal joint, transmission or clutch. Run it in gear again and I'm pretty sure I can locate it."

With the motor turning over in gear, Gus had one hand on the drive-shaft torque tube, feeling for inner vibration, his ear cocked for any sound that might indicate a stripped universal joint, stripped gears in the transmission, or a broken clutch spline shaft. Suddenly a familiar odor smote his nostrils.

"Shut it off, Fraser!" he yelled above the sound of the motor.

Gus came out from beneath the truck, took up the floorboards and removed the clutch inspection plate. Peering into the interior with his flashlight, he saw that the uppermost stud bolt, which held the clutch pressure plate to the flywheel, was backed off and loose. He touched the starter button off and on, to turn the motor one complete revolution. It showed him that all the stud bolts, which held the vital clutch pressure plate to the flywheel, were very loose. Using an extension spin wrench, he carefully tightened each bolt, replaced the floorboards, checked the clutch pedal throw for floorboard clearance.

"Try it now, Fraser," Gus said. "That loose pressure plate had your clutch slipping so much that I could smell hot clutch lining. Maybe it won't pull this hill now with this load. The clutch facings may be too glazed and worn from slippage to do the job."

"It had better," Fraser said grimly, "or I'll go over to Treadway's place and wring his neck. You can bet your bottom dollar that he had Freddy back those bolts off."

Gus shook his head. "I'll admit that the loosening of the stud bolts holding a clutch pressure plate is something that doesn't happen very often, but I'm sure that Freddy didn't loosen these. The dirt on the bolt heads showed that they hadn't had a wrench on them in a long time. Probably the fault lies with the mechanic who installed the clutch. When tightening these bolts against clutch spring pressure a man can be fooled into thinking that they're tight when they're not. Try it and see if it will pull the hill. If you drive as fast as the law allows you'll have time to enter your bull at the fair. It's just a little after nine."

When the truck lunged into the pull, Fraser didn't even look back. He went barreling up Big Hill, while the magnificent bull in the back bellowed tremendously at a comely cow it had spotted in a nearby pasture, no doubt wishing that Gus Wilson had kept his grease-smeared nose out of George Fraser's faulty truck transmission.

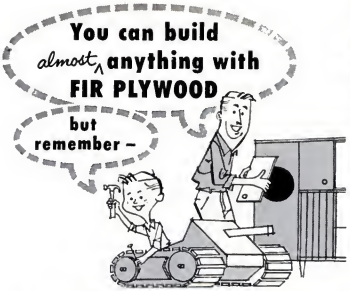
"Notice how this old baby just glides over the bumps?"

STROLLING through the county fair with Stan Hicks a couple of evenings later, Gus smiled to himself when he saw the Treadways and the Frasers standing together in the livestock show admiring the blue ribbon that decorated Fraser's bull. They were talking amiably. Freddy Treadway was laughing and Sally was using her big eyes on him.

"If you hadn't proved Treadway's innocence," Stan Hicks said, "those folks would have been enemies from here on out."

"I doubt it," Gus replied, grinning. "For them, the county fair comes but once a year. Within a month they'd have been leaning over the fence, laughing about it, each one figuring how he could beat the other at the next livestock show." END

NEXT MONTH: Gus makes a miser wiser.



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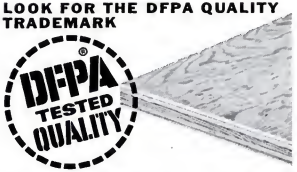

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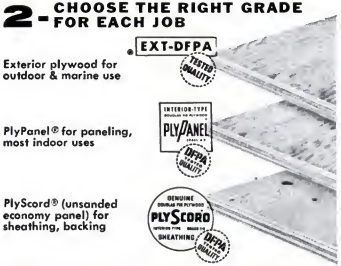

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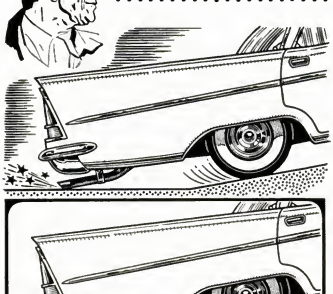
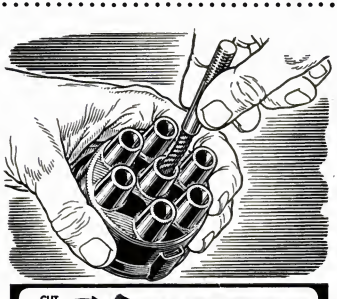
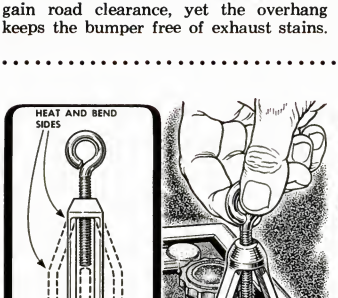
Hints from the Model Garage



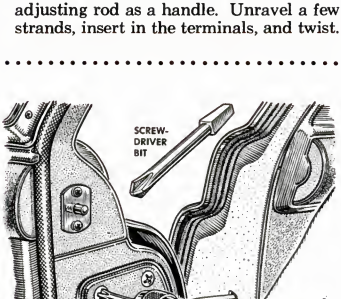
A tailpipe that scrapes as you enter or leave a steep driveway can be cut without shortening it. Hacksaw a piece from the bottom of the pipe at a long angle. You gain road clearance, yet the overhang keeps the bumper free of exhaust stains.



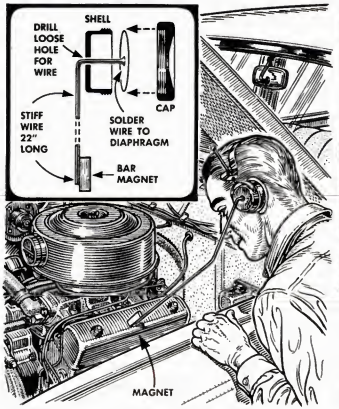
Corrosion can be cleaned from inside distributor-cap terminals with a wire brush made from a discarded hand-brake cable. Cut the cable near its end and use its adjusting rod as a handle. Unravel a few strands, insert in the terminals, and twist.



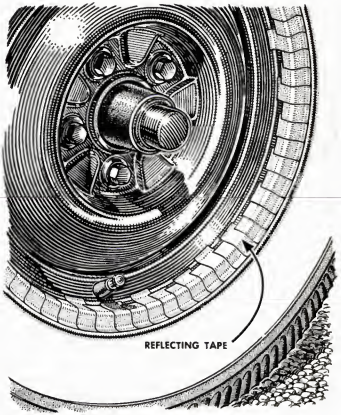
A safe battery-terminal puller can be made from a turnbuckle. Discard the left-hand eyebolt and hacksaw the threaded end down the middle. Spread the sides and file off enough from the split end to make hooks that fit under the cable clamps.



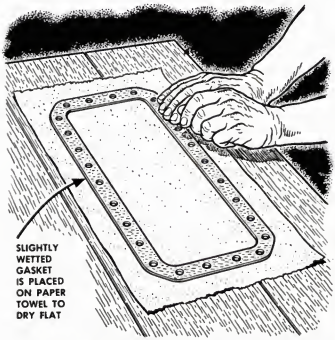
For that extra leverage needed to loosen the adjusting screws on door hinges without damaging their heads, try a carpenter's brace. Screwdriver bits with shanks to fit the brace can be purchased for both Phillips-head and slotted screws.



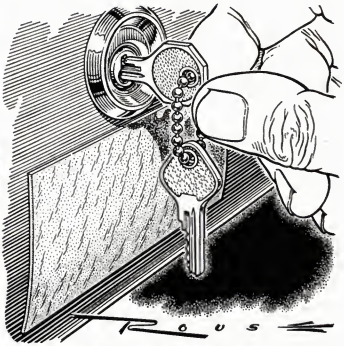
To pinpoint engine noises, use a stethoscope made from a radio earphone. Solder a stiff wire to the diaphragm, and the earphone's magnet to the wire's other end. Touch the magnet to different parts of the engine to listen and trace noises.



Short strips of reflecting tape placed side by side around wheel rims serve two purposes: They reflect an oncoming car's headlights when you drive out of a side street and they eliminate any occasional tendency for the wheel covers to creak.



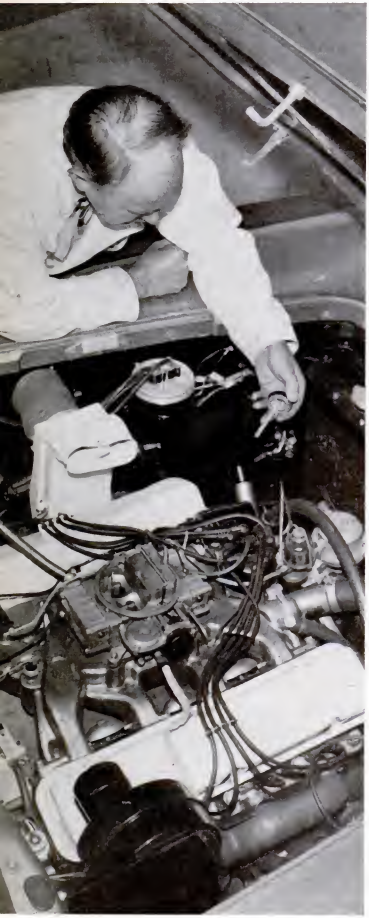
A cork gasket that has shrunk can sometimes be restored to its original size by dipping in water and laying it flat long enough to absorb the moisture and swell. Don't soak it for a long period of time, as it might come apart or crumble.



The noise of keys jangling against the dash can be silenced by cementing a small square of leather to the metal below the ignition switch. Rubber cement will hold it without damaging the finish. Colored leather can be bought at craft shops.

How to Take Care

Advance report to Saturday mechanics reveals inside details



By William Carroll

FROM the startling front "impact" ring to raised-eyebrow tail light, Edsel boasts unexpected ease of servicing and minimum maintenance requirements. Engines are the "E400" of 361 cubic inches (303 hp.) and "E475" of 410 cubic inches (345 hp.) with machined combustion chambers to reduce any tendency to run rough as they carbon with use. Hydraulic lifters are fitted to both engines, and valves need no adjustment.

Three-stage cooling for the E475 engine has two block thermostats holding water in the heads and intake manifold until it reaches 140 degrees. Water then circulates *inside* the block, heads and intake manifold until a third thermostat reaches 140 degrees and permits water to pass through the radiator. The water level should be kept to the bottom of the radi-

ADJUSTING EDSEL POINTS is exceptionally easy, for the distributor is up front, high and unobstructed (see photo at left). With the points open, loosen the locking screw, as below, and shift the fixed point until the specified .014" to .016" gap has been obtained.

# of an Edsel

of America's newest car

ator filler neck. Drains emptying the system are on the lower radiator tank and low down on each side of the block. The bottom heater hose should be removed when draining; otherwise the heater will retain its quart and a half of water. Edsel owners should know too that the engine "Cold" dash light is on when the water is less than 115 degrees, while the "Hot" warning brightens if engine heat exceeds 200 degrees. Both red ("Hot") and green ("Cold") will be lit when the engine is starting.

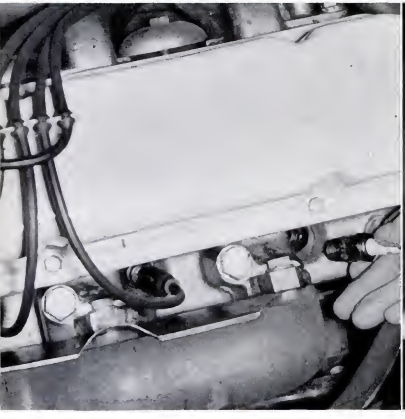
Happy days for Saturday mechanics begin with discovery of the distributor high up in front of the engine. Other parts are equally accessible.

Carburetion is by four-throat Holly or Carter carburetors, which have a screen bowl strainer, plus a fuel-line filter and sediment bowl. Clean both filters every three or four months and drain water from the sediment bowl just before freezing weather hits.

Adjustments to Holly carburetors include accelerator pump stroke, "hot" idle r.p.m. and mixture, and "cold" idle r.p.m. adjustment (see carburetor photos).

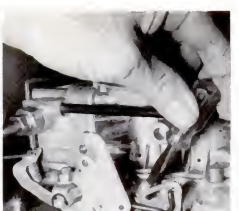
Adjustments of Carter carburetors vary slightly from the Holly. Idle-mixture screws are above the front of the carburetor base. Follow instructions for the Holly carburetor, continuing adjustment of idle-mixture screws and "hot" engine-idle adjustment until a smooth 475 or 500 r.p.m. is reached. To make a "cold" idle adjustment (after the engine is thoroughly warmed), position the fast-idle cam

WELL-PROTECTED SPARK PLUGS require a wrench with a reach to remove them. Plugs should be gapped to .032" to .036". Wires have a resistance cover to minimize interference with the radio, and they are neatly held in place by brackets on the rocker-arm covers.



TIMING is at top dead center, but there are limit marks on the balancer between which timing may be set for maximum performance with varying local fuels. Connect the timing light to the No. 1 (right front) cylinder and disconnect the vacuum line when timing the engine.

IDLE MIXTURE on Edsel's four-barrel carburetor is adjusted by turning a brass screw on each side of the primary float bowl. Adjust the screws for maximum vacuum with the engine 20 minutes warm. If you have no vacuum gauge, turn the screws in until the engine runs rough, out until it rolls from richness, then slowly in again until the idle smooths out.



SET IDLE SPEED to 450 r.p.m. by turning the spring-wrapped screw on left side of carb. If a tach isn't handy, adjust for the slowest reliable idle with transmission in Drive, brakes set.

ACCELERATOR-PUMP STROKE on Holley carbs is changed with the seasons simply by shifting a screw from the No. 1 hole (summer) to the No. 2 hole (winter) in the throttle-shaft lever.

(on the side to which the accelerator linkage attaches) so the "cold" idle-adjustment screw is against the lowest (slowest) step. Start the engine and set the "cold" idle-adjusting screw so the engine idles at 550 r.p.m. The accelerator pump lever of Carter carburetors has three adjustments: an upper hole providing maximum fuel for extreme cold-weather operation; the lower hole to deliver a minimum amount for high altitude or extreme hot weather; the center hole for average use.

The Edsel body is spot-welded together as a separate unit, then tied to the frame by rubber-bushed body bolts which are torqued at 15 to 30 foot pounds. Door alignment is accomplished by loosening cap screws holding hinges to body pillars before shifting the door. Lock striker plates should be set to seal the doors against weather-stripping, and never adjusted to force a door to match surrounding sheet metal. Every 2,000 miles, Lubriplate should be applied to door-lock striker plates, rotors and door-check arms, while light engine oil is squirted into four holes at the door hinge joints. Lubriplate should also be applied to the lock dowel catch, auxiliary hood catch and to the luggage-lid lock. At the same time apply light oil to the hood hinge pivots (four points) and to the hinge pivots of the luggage lid.

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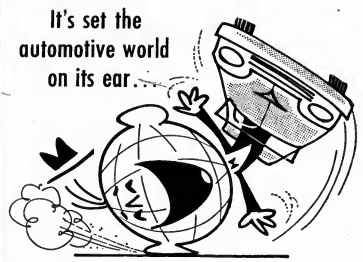

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DUAL HEADLIGHTS are easily replaced after two body screws have been removed from the trim plate. The bulbs are marked No. 1 and 2, and distinctive sockets for each bulb make improper replacement impossible. Loosen only the three screws in the chrome ring.

BLOWN FUSE creates no puzzle, with this junction box up under the dash on the driver's side. Each socket holding a fuse is labeled to show which circuit it protects, making it unnecessary to trace the wires or examine all of the fuse holders.

TAIL- AND STOP-LIGHTS have a dual lens: a white one to distribute the light, covered by a smooth red one. Screws through the flange of the red lens hold both in place. The license-plate bulb is the only one on the Edsel with a pull-out socket for bulb replacement.

HOOD IS ADJUSTED to match fender lines by loosening the hinge-bracket bolts behind the impact ring. The central grille, held by three cap screws, must be removed to make this adjustment. Rubber bumpers can be adjusted to control the closed height of the hood at the cowl.

TORSION BARS, instead of coil springs, lift the deck lid when the lock is opened. Turning the adjusting nuts clockwise as shown provides additional lift for the lid. Slotted holes in trunk-lid hinges permit shifting it to match surrounding metal.

RUBBER PADS in the bumper guards cushion the little jolts of maneuvering in tight parking spaces. One size fits all guards, and they are easily replaced. Bolts on bumper arms have eccentric heads. Loosen the nut and turn the head slightly to raise or lower the bumpers.

taining the lubricant (SAE 90 mild extreme-pressure) to the filler plug. All steering units have a rubber-bushed idler arm that assists wheel recovery to straight ahead (after cornering) through torsion action of the rubber as the idler arm twists from right to left. Do not lubricate this unit as oil deteriorates rubber and could destroy the recovery-assistance feature.

Two types of power steering are found in Edsels. The conventional linkage type (a factory or dealer-installed option) has its pump mounted on the block and the power assist attached to steering linkage beneath the car. The radical departure is integral power steering offered as a factory-installed option. Power assist is in a gear case at the lower end of the steering column. (It's in the location of

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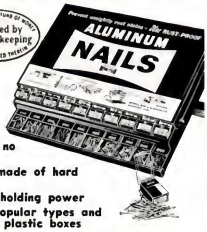

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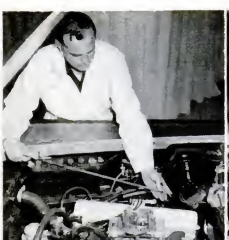
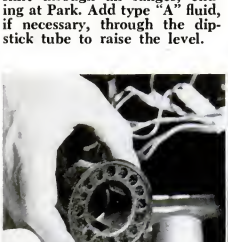


AUTOMATIC - TRANSMISSION FLUID is checked with dipstick at right rear of engine. With brakes set, run the engine for five minutes in Neutral, then shift through all ranges, ending at Park. Add type "A" fluid, if necessary, through the dipstick tube to raise the level.

POWER-STEERING RESERVOIR is at left front of the engine. Check fluid level with the small dipstick on the filler cap, being very careful not to get any dirt in the reservoir. Add type "A" automatic-transmission fluid to bring the level up.

ENGINE-OIL LEVEL *can* be checked by the dipstick, but it isn't necessary. There's a notch in the tubular stick below the required oil level, and if oil drops below the notch, a vacuum (kept constant by the windshield-wiper pump) will fall, lighting a dash signal.



CRANKCASE BREATHER CAP supplies filtered air to ventilate the crankcase. Dunk it in cleaning solvent every 2,000 miles—more often under dusty driving conditions. Allow the cap to drain or shake it dry, then wet the filter element with clean lightweight engine oil.

DRY-TYPE AIR CLEANER is standard on Edsels. Unscrew center wing nut and remove element every 4,000 miles. Tap it on a horizontal surface to shake trapped dust loose. Don't use solvent or high air pressure on it or you'll be buying a new one.

FUEL PUMP AND FILTER are now in plain sight on top of the engine. Their location makes it easier to clean the filter every 4,000 miles. Loosen the clamp screw by hand to remove the bowl and filter. If the element appears greasy or rusty, replacement is a good idea.

the power pump that Edsel discloses future plans. The pump is an integral engine part attached to the crankshaft. It's fairly easy to believe that, on future models, this built-in power source will operate windows, deck lids, hoods, doors, seats and other yet-to-be-announced devices.)

Checking lubricant in conventional transmissions is a mechanic's job during lube sessions as it can only be done from underneath. However, you can check the automatics yourself (see photo).

Engine oil should be drained at 1,000 miles (after break-in), then changed every 2,000 miles or three months, whichever is first. Oil should be hot and the engine just turned off before an oil change is made. This removes the maximum amount of sludge. Both engines

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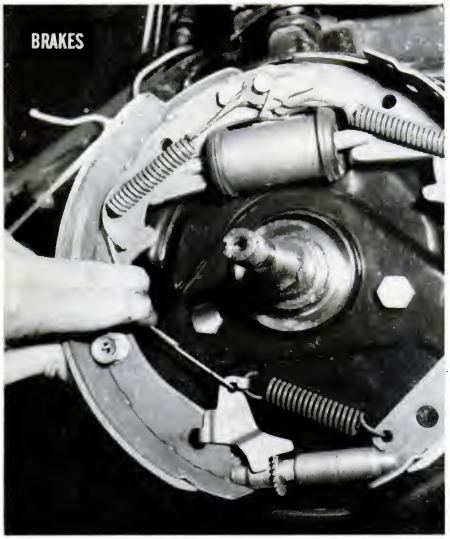

BRAKE MASTER CYLINDER on all Edsel models should be kept filled to within ¼" of the top with heavy-duty brake fluid.

BRAKES ADJUST THEMSELVES: Applying them when the car is being backed causes the brake shoes to move slightly in a track. When they move, a cable lifts a ratchet beside the star wheel. If adjustment is needed, the ratchet will advance one notch on the star wheel as it lifts. Then, when the brakes are released, a stiff return spring pulls the ratchet down, causing it to turn the star wheel one notch. If the shoes are fully adjusted, they won't move.

hold five quarts of MS or MD oil with an extra quart for filter changing at 4,000-mile intervals. To remove Edsel's disposable filter, unscrew the entire assembly (from underneath the forward left corner of the engine) by hand. Coat the new filter gasket with oil, hand-tighten the can until the gasket contacts the adapter face, then advance the entire unit exactly one-half turn. Run the engine a few minutes and check for leaks.

Bendix Duo-Servo brakes have an almost unbelievable adjustment feature: back the car up, apply the brakes, and as the shoes move in their servo slot, they swing a ratchet arm that makes the adjustment for you.

Power brakes have a vacuum tank under the left front fender holding enough vacuum for three to five emergency stops. The only maintenance is to solvent-wash an air cleaner mounted on top of the large cylinder. It is replaced in a dry, non-oily condition. Should the engine stall on a steep grade, the parking brake should be set on the first application of the service brakes. When parking a car equipped with power brakes on an extremely steep grade, set the parking brake firmly *before* turning off the ignition. Before releasing the parking brake, be sure the engine is operating.

Cables to rear wheels of the foot-pedal-operated parking-brake are adjusted at the central equalizer by applying the pedal two clicks, loosening the forward check nut at the equalizer, then tightening the rear nut until the cables are just taut. Retighten the forward check nut to lock the equalizer in place. Release the parking pedal and rotate both rear wheels to make sure the shoes are not dragging.

Stainless-steel and chrome trim should be polished with a chrome cleaner, then waxed to retain a stain-free gleam. The baked-enamel paint on Edsel cars requires only washing to maintain its cleanliness and beauty. Abrasive cleaners should not be used on enamel. They so roughen the glossy surface that, instead of polishing, they will actually dull the paint.

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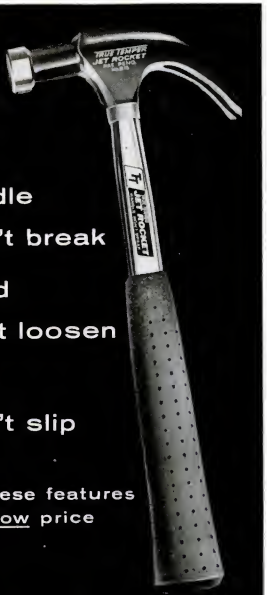

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How to Buy Good Retreads

This is something really worth knowing: It can cut your tire costs in half. Here are useful tips for sorting out the clinkers

By Robert Gorman

BEFORE you plunk down $60 to $160 on replacement footwear for your car, stop and ask yourself a question: Do you really need new tires—or just new rubber on your present ones?

There's a big dollars-and-cents difference, because good retreads, or recaps, can halve your tire cost.

It figures. Seventy percent of the cost of manufacturing a new tire goes into the casing. You can salvage a large part of that investment by replacing the 30 per-

Before you recap a tire, look for:

FABRIC CUTS or breaks. Small-hole patches are safe, but thumping may occur at high speed.

DEEP RADIAL CRACKS that penetrate to the cord. A few shallow cracks needn't doom a casing.

SEVERE WEATHER CHECKING. Rubber may be old, dried out. Capping can't make a bad tire good.

BULGES inside or out that show ply separation. A shop test for separation is essential.

cent of a tire that wears out, instead of throwing away the 70 percent that doesn't. Retreads are today's best buy in tire mileage.

But you can only get your money's worth out of good retreads—and there are other kinds. It doesn't pay to keep your tires through a second lifetime unless:

- They were of good initial quality—first line or better.
- The casings are only worn—not damaged. A tire should not be capped if it has been driven flat; if plies have separated; if fabric is cut, broken, or rotted; or if side rubber is badly checked or cracked.
- The job is done by a shop that backs its work with a cast-iron guarantee.

Truck and taxi operators, who retread a casing up to four times, have proved that it pays off in practice. Many say that retreads give mileage as good as that of new tires, sometimes better; other estimates range down to 75 percent of new-tire wear.

Retreads have other impressive boosters, including the men who buy tires for aircraft landing wheels, racing cars, ambulances, and police and fire-department vehicles. Acceptance for such jobs has helped to demonstrate that quality recaps are no longer anybody's poor relations. Retread men (or "treaders," as they usually call themselves) wish, in fact, that the public would stop coddling their product. Retreads can be used equally well on front or rear wheels, and are up to any service to which you normally put a car. If you must speed, re-

treads don't add at all to your danger.

Nevertheless, there are millions of car-wise buyers who won't touch retreads with a 10-foot pole. When World War II created both a rubber famine and a hungry market for unrationed tires, the treading industry mushroomed. On the whole it did a fair job of keeping cars rolling for the duration, but most people came to regard retreads as substitutes—and pretty poor ones at that.

It wasn't uncommon for poorly bonded caps to tear loose after a few miles, and no one in his right mind would risk driving war treads at high speed. To blacken the reputation of recaps still further, countless thousands failed because they were built on inferior casings.

With this spotty introduction to the motoring public, it's not surprising that tire treading nosedived after the war. But since then, several important things have happened to change the picture.

New-tire manufacturers have been steadily bettering their product, and sturdier rayon and nylon cords have been developed for body fabrics. So stronger, longer-wearing casings are now available.

Retreading know-how, materials and machinery have been greatly improved. And instead of being top-capped, as was once the rule, most tires are now treated to the more satisfactory full cap.

Such changing trends show up in a complete reversal of the wartime situation: Though unsatisfactory retreads are still with us, they now represent a small minority of the total output. As a result, treading has climbed back to an all-time high. This year, some 9,000 shops (including nearly 500 operated by new-tire companies) will turn out eight million truck and 24 million passenger retreads.

Despite high average quality, however, you still have to be on guard against clinkers, because every retread is individually processed, and many things can affect the result. The service and value you can expect will depend largely on the skill, experience, equipment—and integrity—of the shop that does the job.

Industry spokesmen acknowledge that there just aren't enough cappable casings to meet the booming demand. But rather than lose sales or raise production costs, some less ethical treaders process casings that properly should be scrapped.

And if he's not greatly worried about building his reputation, a retreader can shave his costs in other ways that do you no good. Tread rubber is manufactured in different qualities and thicknesses. By skimping on either or both, a processor cuts his costs—and your mileage.

Does it make any difference whether you have your own tires capped, or buy ready-mades out of stock? Not necessarily, but it does make sense to consider your own tires first. At the very least you have a good basis for judging their original quality and their present condition.

You can rule your tires out right away if you bought them as third—or even second-line—bargains. These tires may be

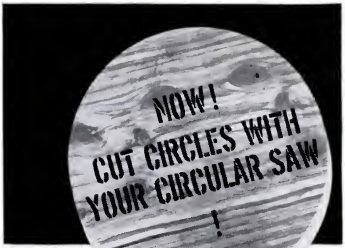
CAP or TREAD?...take your pick

SOME treaders call the application of tread rubber (or camelback) a "recap"; others prefer "retread."

Top cap—or top tread—is replacement of just the band of rubber that touches the road. Some people call this a recap to distinguish it from a retread or full cap.

Full cap—or full recap, or full tread—involves rounding the shoulders as well as the crown, and replacing rubber down to the scuff bar or curb ring. But some tire men call this a recap to distinguish it from a top tread.

Tire literature contains still other confusion. B. F. Goodrich, for example, uses the names "top cap" and "full recap" for types shown at left; it saves a third term, "retread," for a rarely used job in which the shoulders are buffed away and new rubber applied.



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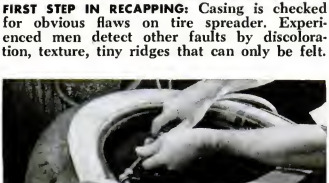
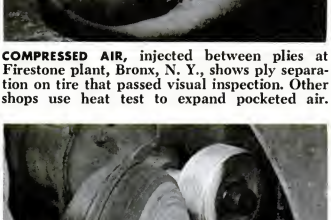
How a tire is recapped

FIRST STEP IN RECAPPING: Casing is checked for obvious flaws on tire spreader. Experienced men detect other faults by discoloration, texture, tiny ridges that can only be felt.



COMPRESSED AIR, injected between plies at Firestone plant, Bronx, N. Y., shows ply separation on tire that passed visual inspection. Other shops use heat test to expand pocketed air.



BUFFING (or rasping) removes the old tread, and gives the base an even, roughened surface for a good cement bond. Contour varies with size and make, must be checked with templates.

suitable for limited service when they're new, but the casings rarely have enough built-in strength to last out a second lifetime. And it is probably safest not to retread tires if they came on a dressed-up used car. Many of the worst tires going—including retreads of defective casings—are traded in and out of used-car lots.

But assuming that your tires came as original equipment on a new car, or that you bought new first-lines or premiums, they are likely to be good candidates. It helps if you took good care of them in the year or two they were wearing out their first treads, if they gave no serious trouble in that time, if you never drove them flat, and if the tread hasn't worn down to bare fabric.

The importance of original casing quality can't be overemphasized. But don't let yourself get snowed under by rumors about nylon versus rayon, or special perils in capping tubeless tires, self-sealers, or 14-inchers. Some shops have had difficulties with nylons and tubeless, but leading treaders now report that any sound casing can be successfully capped. Bear in mind, however, that after their first year or two of service, some tubeless tires begin to lose air-holding "integrity." If this shows up during a retreader's inspection, he may refuse to process it unless it will be used with a tube.

The time to retread your old tires is before the original grooves have worn away. You can then be sure there will be enough rubber left for a good undertread and a sound rubber-to-rubber bond.

Do you have to buy an extra pair—or set—of tires to ride on while you're having your old ones renewed? Not at all. On request, most retreaders will provide same-day service, whether you deal directly or through a gas station or other retail outlet. You just leave your car in the morning and pick it up in the evening with the retreads in place. Or if you don't want to leave the car, you can arrange to borrow tires for the time yours are in the shop. (Some treaders, however, charge an extra fee for mounting and demounting "loaners.")

A major advantage of having your own tires retreaded is that you can examine them for defects before applications of heat and paint cover the traces. If you have any worries about your own casings being switched for inferior ones when you

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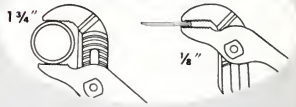

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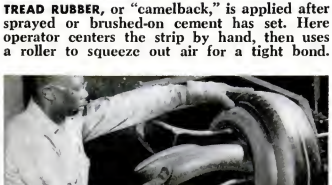
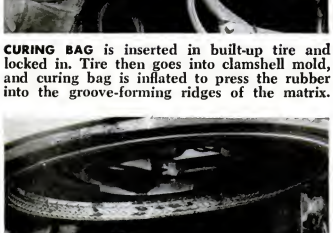
How a tire is recapped [Continued]

TREAD RUBBER, or "camelback," is applied after sprayed or brushed-on cement has set. Here operator centers the strip by hand, then uses a roller to squeeze out air for a tight bond.



CURING BAG is inserted in built-up tire and locked in. Tire then goes into clamshell mold, and curing bag is inflated to press the rubber into the groove-forming ridges of the matrix.



VULCANIZED TREAD is very similar to new tire's when curing time and temperature are carefully controlled. This mold uses steam to vulcanize rubber; others are heated electrically.

turn your back, copy the serial numbers off the sidewalls.

What happens if you decide not to use your tires, or if inspection shows up faults that make one or more unsuitable for capping? You can still take advantage of retread economy by buying tires out of stock. Present trends favor this method of buying by about two to one, but since it leaves you with fewer clues to the condition or quality of the original casing, you should shop with a little more care.

You might take an extra-close look at price-promotion retreads offered by dealers who don't take your old tires in trade. Because their suppliers have to scrounge for casings, they may be tempted to use some that aren't up to scratch.

There's no way you can see the difference between cheap rubber and the better, longer-wearing kind, but you may be able to tell whether you are being short-changed on quantity. According to the standards of the Tire Retreading Institute, a leading trade association, minimum groove depth should be no less than 10/32″ on passenger tires; many shops now use 11/32″ or 12/32″ molds for regular tires, and up to 16/32″ for snow caps. You can check tread depth by taking along a narrow ruler or probe when you shop.

However, this measurement doesn't give you any information about the depth of the undertread, or the quality of rubber or workmanship. So your best protection is to know your retreader or dealer.

Don't settle for less than the equivalent of a new-tire guarantee against tread and ply separation and other basic defects. You should be able to bring a tire back for adjustment if it's a thumper.

Fairly standard contracts cover free replacements within a three-month period, and proportionate adjustments (based on time or mileage) on tires that go bad after that. However, many treaders guarantee against defects for the life of the tire, and some will replace a tire that fails for any reason—including tube blowouts, glass cuts, and other hazards.

With that kind of guarantee, backed by a good reputation, you can hardly go wrong. Tens of millions of good retreads have proved themselves in every kind of service. Reliable treaders say the only thing that distinguishes them from new, first-line shoes is that they cost only half as much. END

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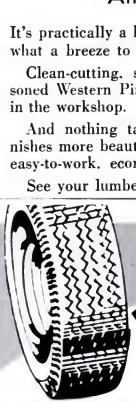

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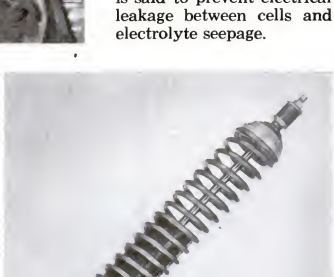

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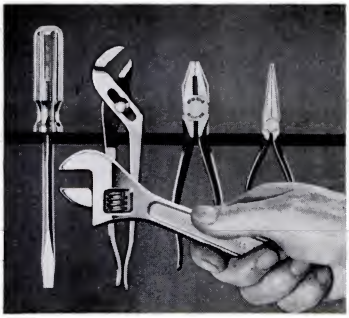
More information *about the products shown on this page can be obtained from: 1. Plasti-Kote, Inc., 9801 Harvard Ave., Cleveland 5; 2. National Assn. of Auto Trim Shops, 1123 Broadway, NYC. 10; 3. Monroe Auto Equipt., Monroe, Mich.*



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Hi-Fi and Electronics

Why Buy a Tape Recorder?

Hi-fi fan? Family man? Gadgeteer? Here are a few of the uses you'll find for the machine that makes its own sound

SOUNDS OF TODAY will make interesting listening tomorrow. Who can say that the growl of this passing diesel locomotive won't become as rare as yesterday's thundering steam exhausts?

This year, half a million Americans will buy home tape recorders. They, and 1,500,000 earlier customers, will also buy enough magnetic tape to reach 12 times to the moon. How can 2,000,000 tape recordists justify spending from $100 to $2,000 apiece for this electronic gadget? We asked this question of a man who's convinced that these little boxes with a memory for sound are an indispensable part of modern living. Here's his answer:

By Henry B. Comstock

MY FIRST brush with recorders came a year ago when my teenage son decided he couldn't live without one. He reminded me that he and a high-school buddy with a tape recorder had just rated a couple of A's for a history project that they had submitted the modern way—on tape. It began with a stirring tuba blast, followed by an Edward R. Murrow-like voice intoning: "Ancient Rome was more than a city; it was a way of life."

"I blew the horn," Bob said modestly.

When that sales pitch failed, he and his friend Dick tried another. They knew my soft spot—trains. I had once edited a railroad magazine, and will still go miles to watch the flanged wheels roll.

With an assist from our local station agent, Bob and Dick ran an extension cord out of his telegraph bay, and made a recording of a diesel plodding upgrade with a mile-long freight. When they turned it on in our living room, the windows rattled with the drub of wheels on rail joints and the groan of straining drawbars. The only thing I missed was the

ANGLING FOR A FEW WELL-CHOSEN GURGLES to add to the family sound album is part of the fun. Dud footage isn't wasted. It's snipped out, spliced on the end of the spool and used again.

bluster of a steam locomotive at the head-end, and the wail of an honest whistle.

Bob had counted on that. He reminded me that there were still a few far-off spots where such a recording could be made. I threw up my hands. I knew when I was licked.

But not my wife.

"I can get along without boxcars running through the house," she said. "What we really need is something that will make our records sound less scratchy."

"***Those records are ruined*** already," Bob assured her. "That's the trouble with records—they wear out." Then, in an aside to me: "This situation calls for pre-recorded tape."

The next day he and Dick were back with Dick's recorder. They also had a bright-colored carton of tape and a length of wire that I've since learned to call a patch cord. While Bob threaded the tape to the receiving spool, Dick plugged one end of the cord into a jack on his machine, and anchored the clips at the other end to the terminals on my own hi-fi speaker enclosure.

"Doing this," he said, "cuts out the

CANNED COMMENTARY for showings of travel slides doesn't try to prove that every picture is worth a thousand words. Often, a bit of dubbed-in music will take care of continuity.

little speaker cones on the recorder. You'll think you're in Carnegie Hall."

We did. The music was unbelievably brilliant and crisp, without a trace of background noise. As *Eine Kleine Nachtmusik* slid over the playback head you could almost see the periwigs bobbing.

"You buy it like old-fashioned LP records," Dick shouted over one crescendo. "Fifty manufacturers to choose from. More than 1,100 selections—opera to bebop. Language lessons, poetry and dramatic readings, too."

My wife was impressed.

"How much music is there on a tape?"

"Seven-inch spool lasts an hour, if you buy it for a dual-track machine like mine. That means you play along half the width of the tape for 30 minutes, then flip the spool and play along the other half."

Dick should have stopped right there. He didn't. "Of course, pre-recorded tape still costs a good bit more than records. But the price is bound to come down."

"What would we pay for a spool like this?"

"Eight ninety-five."

"Why, that's more than twice the price of an LP record!"

"Sure. But this tape is good for hundreds of playings without a sign of wear. If it breaks, you just stick it together with splicing tape. Not even a click to show where you put the patch on."

At this point Bob cut in. He had played enough football to know that you change your strategy when you're being pushed back up field.

"Personally," he said, "I'm all for saving money by making our own musical

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FAMILY MEMO TAPE tells Mary, just home from school, that her aunt will be back from shopping by the time the hall clock strikes three, and what's in the refrigerator for a snack.

recordings. We can pick up anything we want from radio or TV."

It was a good try. But my wife shook her head. "Scratches or no scratches," she said, "we'll stay with records."

During the next few weeks I did a bit of researching. I learned that almost nobody buys a tape recorder for as obvious a reason as replacing a phonograph. There has to be a gizmo—some highly personal angle that may seem unimportant and even zany to the other fellow. Here are a few samplings.

A family was going on a trip. They knew from experience that their dog wouldn't eat when left with neighbors. So they bought a tape recorder, whistled into it a couple of times and said: "Good boy; come eat your yummies." It worked.

An entomologist bought his to eavesdrop on insect sounds. An amateur poultry farmer bought one so he could record a rooster's crowing at sunrise, and play it in his hen house at time-switch-controlled intervals throughout the night.

With this information, I dealt a fast card off the bottom of the deck. We had a little niece and nephew living with us. Three-year-old Johnny still felt that a woman's place—his aunt's, at least—was in the home. An hour after we made our first attempt to leave him with a baby sitter, we were back home.

I waited until my wife had exchanged her party finery for a housecoat.

"You know," I said, "I'll bet a tape

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recording of your reassuring voice would handle situations of this kind. Also, have you noticed how often little Mary has been saying 'yeah' lately? If she could hear herself, she might reform."

My wife sniffed. "She got those 'yeahs' from you." Then: "But it *would* be nice to keep a record of those two on tape. The way they say grace together, and those little songs of Mary's. She has a good voice and perfect pitch."

A week later we bought our recorder.

It cost us less than $150—a price that would make fanatical recordists raise eyebrows. But I like to think that, within limits, what you get out of a rig—whether it's a tool, camera, or tape recorder—is pretty much up to you.

Our machine has the basic capabilities for good performance: two tape speeds (one for run-of-the-mill stuff, the other for fine sound), a "magic-eye" tube to determine the right recording level, an odometer that pinpoints individual sections of tape for erasure or playback, and two input and two output jacks.

Kill-joy audiophiles tell me the frequency range of our recorder falls a little short of hi-fi phonograph perfection. That didn't bother me after I learned that, having passed the age of 45, I probably couldn't hear those top sounds anyway. But if you're really fussy, you can buy recorders that out-span the frequency range of the best LP records. And if you want the ultimate in reproduction, less than $500 will buy a binaural tape machine. With it, you'll have more than 1,000 pre-recorded stereo-sound selections to choose from. These models will also record and play back regular monaural sound.

During the past nine months we've discovered, as most tape-box owners do, that the biggest return we get is good music of our own choosing. We have some pre-recorded tape. But that's like an amateur photographer buying picture post cards; the big boot comes from shooting your own.

Let's say there's a TV spectacular coming up. With our recorder patched in behind the speaker we can have our cake and eat it, too, for the unobtrusive tape

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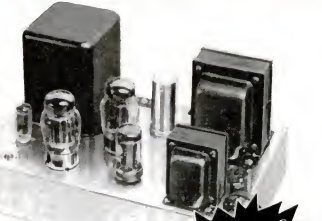

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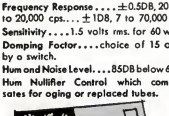

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What's Coming in Tape Machines?

WHETHER you're a hi-fi fan or a casual phonograph listener, you may be switching from records to tape sooner than you think. Four main things, say the experts, will put tape recorders into millions of homes within the next few years:

- Lower tape speeds will slash costs by putting two to four times as much time on each reel. Professional machines move tape at 15 inches per second; hi-fi tapes for home playback are now paced at 7½ i.p.s. To get equal quality at lower speeds, the magnetic-recording-head gaps across which tape passes are being narrowed to a fraction of a hair's width. Experimental laboratory machines are putting out hi-fi sound at 1⅞ i.p.s. At this speed, a 600-foot (five-inch diameter) tape reel could hold as much as two hours of music.
- Cartridges that eliminate loading, threading and rewinding operations will give tape the convenience of discs. Now used on some special-purpose machines (Pentron, Viking, Mohawk), they will soon be available for home players. Cartridges are self-threading; you just pop them on and push a button.
- Stereophonic sound, an exciting development, will get a big boost from dozens of low-cost players and adapters coming on the market this year. Stereo uses two simultaneous sound tracks recorded from slightly different angles. Played back through separate magnetic heads, amplifiers and loudspeakers, they give you the feeling of space, distance and direction you get from listening to a live performance.
- Tape doesn't wear out. Unlike a grooved disc, it doesn't get scratchy, either. So whether you collect stereo or regular (monaural) sounds, your tapes will be as clean the thousandth time you play them as they are the first.

won't interfere with the picture or sound.

We're selective in our radio and TV pickups. If a recording doesn't satisfy us, we erase it at once. We keep individual spools for Bob's jazz, tunes that Mary and Johnny like, musical comedies, and my wife's favorite operas and symphonies. This prevents hodge-podge concerts, or constant switching of spools.

We use the same system for special tapes. Bob has a small roll for homework. A recitation played back a dozen times before going to bed has a surprising way of planting itself in his memory. My wife has a tape that she leaves on the recorder when she's out and wants a word with us. A red card on the table beside it is a signal for Mary, just home from school, to flip the switch. The box tells her to change to her yellow dress, and what's in the refrigerator for a snack.

Then there's that family sound album. Since you can't be selective when you're angling for your grandson's lustiest wail, we catch-as-catch-can, snip out the prize excerpts, and splice them together.

Bob and his friend Dick go for more elaborate editing. With two tape recorders and the Les Paul technique, they think nothing of building themselves up into a 12-piece band, imposing one instrument after another on successive recordings. They have also collected a weird assortment of special audio effects, ranging from New York Harbor sounds to a dynamite blast in a stone quarry. They dub these into what they've tried to convince me are educational tapes for school use.

We never inflict tape-box entertainment on friends unless they ask for it. The only exception is the running commentaries we've recorded to go with showings of color slides. Like the minister who wanted to hear what one of his sermons sounded like and fell asleep halfway through the playback, I've learned to trim my recorded travel talk to a minimum—a kindness to both the pictures and our friends.

We're constantly finding new uses for our box. The other day, for example, we sent our first tape-letter to a fellow recordist. That's going to be a big use for these machines, now that they've passed the novelty stage.

Their versatility in dozens of personal and family uses convinces me that tape recorders are a firm part of tomorrow. END

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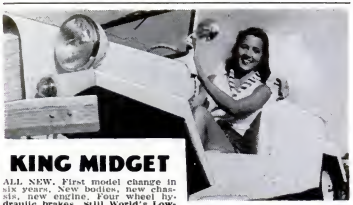

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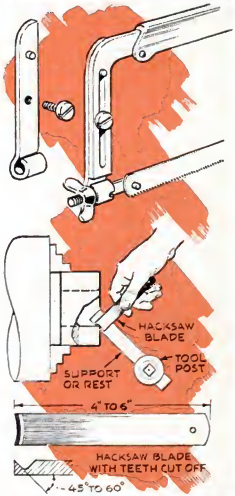
The POPULAR SCIENCE Shop Notebook

Reading the sizes stamped on drill shanks can tax eyes to the limit. Dab light-colored paint on the shanks and wipe off the excess. Enough paint will stay in the markings (right) to make them easy to read, even in poor light.—*F. A. Javor, Newark, N. J.*

Glued corner joints look better—especially when they're painted—if a little fillet is formed along the inside corner to relieve the sharp angle. After clamping, wipe the squeezed-out glue from the joint with a rag draped over one fingertip. This will clean out the excess glue, yet leave a small amount in the corner. Brush fine sawdust over it and let it dry. The finer particles will cling to the glue line, forming a neat fillet.—*C. C. Cooley, New Buffalo, Mich.*

A hacksaw will cut deeper if its throat is widened by adding an extension to the front of the frame. Cut off the eye that holds the blade tightener and cut a vertical slot in the frame by drilling a series of holes and filing them out. Bend a new eye for the blade tightener in a piece of metal strip and cut it to the same length as the original front leg of the frame. Rivet a guide pin near the top of the strip and tap a hole about midway for a locking screw. Loosen the screw and slide the extension down for maximum cutting depth.—*C. H. Willey, Concord, N. H.*

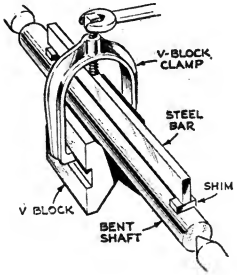


Metals can be turned with hand tools almost as easily as wood. The trick is to grind the tool sharp and support it as close to the work as possible. This radius-turning tool is a good example of a hand tool for metal. To make it, grind a shallow curve across the end of a piece of heavy hacksaw blade, then hold the flat side against a corner of the grinding wheel to grind a back-rake angle behind the curve. Position the lathe's tool-bit holder in front of the work to support the tool. Shave off the metal freehand, checking it frequently with a radius gauge or template. Move the tool support closer to the work as material is removed.—*G. Schlenk, Drexel Hill, Pa.*

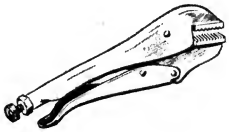
Don't discard a broken steel tape. It can be more useful than when it was whole. Short pieces snipped from it in ¼″ to 6″ lengths make it easy to measure in tight spots where longer rules won't fit. A pin vise makes a good holder for the small scales. A 2′ or 3′ length tacked to the edge of your workbench is handy for such common jobs as taking quick measurements, or sizing the width and thickness of stock.—*Phil McCafferty, Cedar Rapids, Iowa.*

Please turn the page for more shop tips

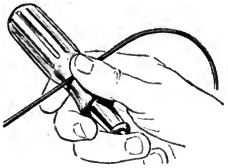
The POPULAR SCIENCE Shop Notebook



Got a shaft that needs straightening? You can unbend it accurately between the centers of a lathe—even a woodworking lathe—without damaging the machine. Support the shaft between the head and tailstock and rotate it by hand until the hollow side of the bend faces up. Place a small block of hardwood on each end of the shaft and straddle them with a steel bar that's heavier than the shaft. Squeeze the shaft and the bar together with a C clamp or V block; the bar won't flex but the shaft will. Overbend the shaft a bit to compensate for springback. Remove the bar and rotate the shaft against a dial indicator to see if it is true. Repeat the process, if necessary, to completely remove the bend.—*H. J. Gerber, Stillwater, Okla.*



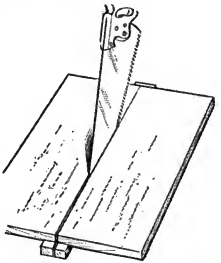
You can lock the jaw adjustment of cam-action pliers simply by adding a lock nut to the adjusting screw. Remove the screw, then twist on a nut of matching thread and screw it back into the handle. After setting the required jaw opening, run the nut up tight against the handle of the pliers to lock the adjusting screw.—*Arthur B. Welch, Syracuse, N. Y.*



Wire that's kinked and bent can be quickly restored to factory-fresh condition. Fasten one end in a vise and pull the wire taut. Then run a hardwood dowel or a plastic screwdriver handle firmly down its length, or, if easier, draw the wire between thumb and screwdriver handle with a motion similar to combing long hair. After a few such passes, the kinks will disappear and the smoothed-out wire will take on a long, uniform curve, making it easy to roll into coils for storage.—*R. J. Cotton, Chicago.*

HAVE YOU TRIED THIS?

To prepare a butt joint for gluing without the convenience of a jointer to produce matching edges, try this: Place the two pieces edge to edge and lightly nail a strip of scrap wood over the joint. Invert the pieces and saw *along the joint line.* The saw kerf will remove material from both meeting edges and any variation on one edge will be compensated for on the other. After the scrap has been removed and the two pieces glued, the joint will be perfectly fitted.—*Rev. C. R. Moase, New Wiltshire, P. E. I., Canada.*



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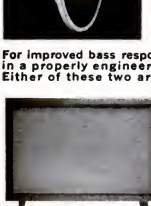

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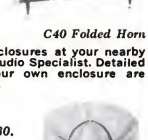

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Short Cuts and Tips

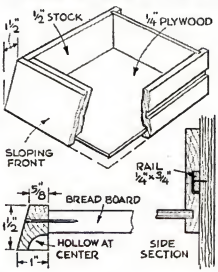
FROM PS READERS

Tape Strengthens Pages of Loose-Leaf Book

I CLIP out the Fix-It File and many other PS articles, and keep them in a loose-leaf book. Since the book gets lots of handling at our house the pages need some reinforcement more rugged than the usual tiny circles stuck on at the ring holes. Because of its extreme toughness, I settled for masking tape.

I sandwich the cut edge of each page between long strips of tape. Half the width of each strip extends beyond the page and I punch the holes in this double-tape thickness.—*R. E. West, Newark, N. J.*

Cabinet with Angled Drawers Needs No Projecting Handles



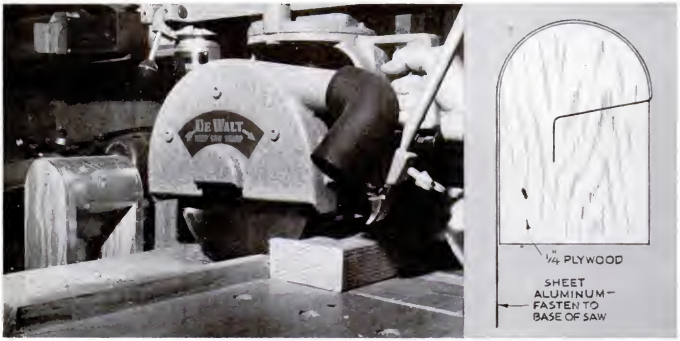
TILTED drawer fronts give this kitchen cabinet a clapboard-like face with no dangling pulls or protruding knobs in sight. Finger grips are hollowed out in the overhang.

The drawers are grooved at the sides to slide over rails, but otherwise internal construction is conventional. A bread board above also has an angled front.—*Hi Sibley, Nuevo, Calif.*

Short Cuts and Tips

Soft-Drink Bottles Make Movable Insulators on Electric Fence

You can cut costs when installing an electric cattle fence if you use pop bottles for insulators. And you get a fence that can be relocated easily, too. Just drive ½″ rods into the ground for posts, up-end a bottle over each one, and loop the electric wire around the necks of the bottles.—*Fred R. Allen, Grand Junction, Colo.*



Trap on Saw Sends Sawdust to Catch-Box on the Shop Floor

A hooded deflector keeps sawdust from messing up my shop as fast as it used to. I cut two side panels from 4″ by 6″ scraps of ¼″ plywood, wrapped a strip of thin sheet aluminum around them and stapled it to the edges. After cutting a mouth opening, I bent the metal flap inward and downward to deflect sawdust to a box under the opening in the base. Some sawdust from the radial saw still escapes, but enough is trapped to make for a big improvement.—*Darrell Huff, Sonoma, Calif.*

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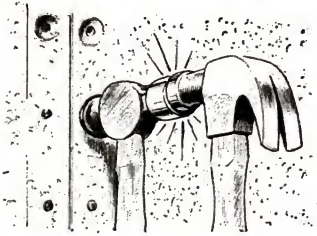
Short Cuts and Tips

Wire Locates Electric Cable

MUCH of my work as an electrical contractor is putting in receptacles in side walls on the first floor. I save guesswork and time by making a small hole in the floor below the receptacle and pushing through a fine wire. When I go below, I measure from the wire to the midpoint of the wall, and this shows me where to drill for the electrical cable. After the connection is made, I plug up the floor hole with a match stick. When I have to go to an upper floor to pick up the line, I poke a wire through a small hole in the ceiling. The hole is too tiny to be noticed later.—*I. R. Hicks, Centralia, Mo.*



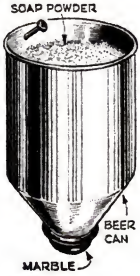
Two-Hammer Trick Saves Board

I'VE found a sure and simple way of protecting wallboard from a slip of the hammer when I am countersinking the nails used to attach it. I place the ball of a ball-peen hammer against the head of the partly driven nail. Then I hit the flat face of the hammer with another hammer and the nail is set. The little dimple made by the ball of the hammer makes it easier later to fill in the nail holes with plaster. —*G. L. Strobeck, Irwin, Pa.*

Mop-Up Jobs? Keep Paper Near

FOR many jobs—from wiping off an oilstone-honed blade to mopping up paint remover—a piece of newspaper can be the handiest item in a shop. To keep a supply on tap, I pile up old papers an inch thick and cut the pages into quarters with a knife. Then I use an old drill to make a hole and hang the stack of papers on a nail with wire.—*Simon Liebowitz, New York City.*

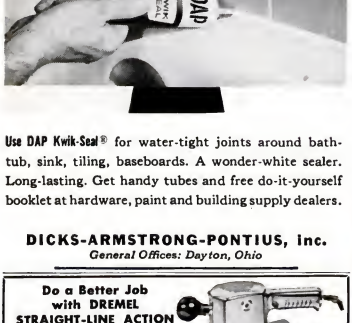
Beer Can Is Soap Dispenser



WITH a beer can and a marble you can make a handy shop soap dispenser. Cut away the bottom of a can like the one shown, drop the marble in the funnel neck and nail the can to the wall. Fill the can with granulated soap. Push up on the marble to get soap.—*J. A. Comstock, Wellsboro, Pa.*

Do it now with

DAP



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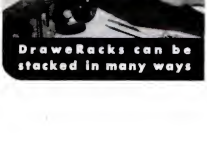

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All About Ford's Edsel

[*Continued from page 103*]

So the rear fenders were lapped over, and the tail-light pattern took on a gull-wing appearance.

A second major decision was that the car had to have an individuality of appearance that would keep it safe from confusion with any other car. At a block and a half, other cars looked alike. All the grille lines were horizontal.

The stylists doodled and doodled to get something different. In the end there was only one answer—a vertical motif. That accounts for the egg-on-end ellipse on the front of the car with an "impact ring"—irreverently referred to by some Edsel per-

An article on how to take care of a '58 Edsel appears on page 242.

sonnel as the "horse collar"— in the center. The nostalgic touch is deliberate. It smacks of the old La Salle or Packard.

"We wanted something familiar," explained a Ford stylist, "so the customers could 'identify with it.' "

The vertical grille design led inevitably to a hump in the hood—a "strong definition instead of a slope-off." Edsel men insist that the hood design provides the motorist with a sense of direction.

The decision to add the Edsel to the Ford Motor stable of cars, at a cost of a quarter of a billion dollars, was strictly self-protective. The company figured it was losing 100,000 customers a year to competitive manufacturers as Ford car owners "upgraded" to costlier vehicles. Chevrolet owners could upgrade to Pontiac, Buick or Olds, and Plymouth owners to Dodge, De Soto or the Chrysler Windsor. Ford owners could upgrade only to Mercury and still stay in the family.

Medium-priced cars, including the top grades of Chevy, Ford and Plymouth, account for 60 per cent of all U. S. sales.

Ford Motor hopes now to keep a lot of that truant cash in its own till.

Implementing the Edsel's introduction is a campaign to establish dealerships selling only the one car for "more stalls in the market place." Norman K. VanDerzee, the sales head, has some 1,400 Edsel-only dealers among a total of 1,500. The others sell other Ford Motor cars, too.

Because plans for any model-year are locked up a full year ahead of a car's ap-

pearance, Edsel is in an unusual position.

"Here we are," remarked one member of the styling staff just before the car's unveiling, "finishing up plans for the 1959 lines of cars, and we're not even on the market yet with the first Edsel."

Now he's busy working on plans for the 1960 Edsel. END

Specifications of the 1958 Edsel

All four lines of cars—the Ranger, Pacer, Corsair and Citation—have the following attributes in common:

Engines: OHV V-8's developing maximum horsepower at 4,600 r. p. m. and torque at 2,800 r. p. m. Compression ratio, 10.5:1.

Rear-axle ratios: With standard transmission (available on Ranger and Pacer only) 3.7:1; with overdrive, 3.89; with automatic transmission, 2.91 or 3.22; station wagons, 3.89 or 3.7.

Steering ratios: 31.8:1; power, with standard transmission or overdrive, 29.7; power, with automatic transmission, 23:1.

Springs: front coil, rear semi-elliptic.

Tread: front 59.4 in., rear 59 in.

RANGER and PACER

(Model: four-door sedan)

Engine: 303 hp.; torque 400 lb./ft.; bore and stroke, 4.05 in. by 3.5 in.; displacement, 361 cu. in.; engine piston travel in feet per minute at 40 m.p.h., 1,310.5.

Transmission: standard, overdrive or torque converter.

Brake-lining area: 191.5 sq. in.

Outside dimensions in inches: height 56.3; overall length with bumpers and guards, 209.9; width 78.7; wheelbase 118.

Inside dimensions in inches: seat-cushion width front and rear 60; leg room front 43.1, rear 40.7; headroom front 33.8, rear 33.5; seat height front 10.7, rear 13.9; vertical distance, steering wheel to seat cushion with seat in mid-position, 5.6.

Tire size: 8.00 by 14.

CORSAIR and CITATION

(Model: four-door hardtop)

Engine: 345 hp.; torque 475 lb./ft.; bore and stroke, 4.2 in. by 3.7 in.; displacement, 410 cu. in.; engine piston travel in feet per minute at 40 m.p.h., 1,342.3.

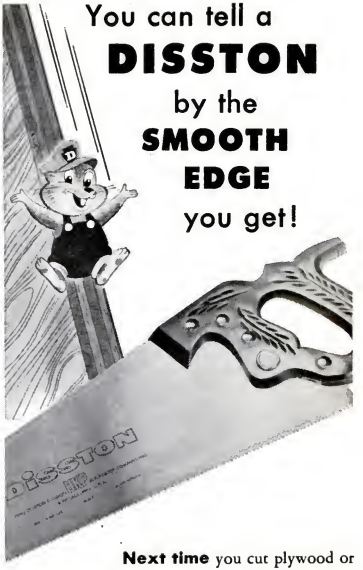
Transmission: torque converter.

Brake-lining area: 212.8 sq. in.

Outside dimensions in inches: height, 56.8; overall length with bumpers and guards, 218.7; width, 79.8; wheelbase, 124.

Inside dimensions in inches: seat-cushion width, front 63.2, rear 63.6; leg room, front 44.2, rear 43.4; headroom, front 33.8, rear 32.7; seat height, front 10.5, rear 14.4; vertical distance, steering wheel to seat cushion with seat in mid-position, 5.2.

Tire size: 8.50 by 14.



Next time you cut plywood or other well-seasoned woods, use a 10-, 11- or 12-point Disston Hand Saw. Note how easily it cuts . . . what a beautifully smooth finished edge it leaves! That's because these fine-toothed saws are specifically designed for finishing work. Made of fine tool steel, with perfectly tempered and double taper ground blade, Disston Saws give years and years of service, too.

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The Standard Products Co.
LEXINGTON, KENTUCKY

How Disaster Strikes
[*Continued from page 108*]

killed 235 children aged up to four and 268 people over 70—but only 37 people aged 20 to 24.

The result, many fire experts think, will be a rise in disasters such as the one in Warrenton, Mo., early this year. In that tragedy, more than 70 people died in a nursing-home blaze. There have been enough such catastrophes recently to start a probe by the Social Security Administration of nursing-home conditions.

How about vehicle catastrophes—air, rail and highway? In the past 15 years, air and auto catastrophes have increased steadily while rail disasters have dropped. "The reason," says a National Safety Council official, "is largely that air and auto travel have grown, while railroads have concentrated all their increase in freight rather than passenger traffic."

From 1941 to 1955, U. S. airlines boosted their traffic from a little over a billion passenger miles to some 23 billion. With more planes flying more people, there were more air disasters. The record shows there were almost three times as many people killed in air catastrophes during the 1951-1955 period as in 1941-1945. This does not mean that air traffic has grown riskier; by the only rational index, deaths per million passenger miles, it has grown steadily safer.

Meanwhile, railroads saw their passenger traffic slide downward, from 29½ billion miles in 1941 to 28½ billion in 1955. This, together with new safety equipment, helped drop the disaster tolls among the nation's railroads.

All indications point to still more expansion of air and highway travel in the decade ahead. So you can expect aircraft and motor vehicles, along with fires and possibly tornadoes, to bulk largest in the next 10 years' disasters.

Can you protect yourself against disasters? Not easily. It's obviously a good idea to check on fire dangers in your home, and to get rid of such wind hazards as dead trees. And to check your insurance policies—you may find that you can't collect if your home is wrecked by waves, overflowing lakes and streams, snow, sand or dust. If you're barred from payments in these cases, you may be able to add low-cost coverage. END

[Continued from page 113]

we were rolling again, I asked him what drivers did about such embarrassments as drunken riders or stowaway pets.

"If a drunk is willing to sleep it off, we let him be," he said. "If he makes trouble we get him off; we'll call the cops if we have to. The only animals we'll take are Seeing Eye dogs escorting a blind person. But sometimes a passenger smuggles through a Chihuahua in a pocket, or a kitten in a carton."

Drivers won't pull up to help a woman change a tire, but they will stop to put out an auto fire or supply first aid.

To become a Hound driver, as they're called among themselves and truckers, you first pass a series of aptitude tests (with enough psychological checks to discover your boiling point in tough traffic or with cranky passengers). Then you go for training in regional driving schools. About one in 10 applicants is taken on.

The 156-mile Indiana Toll Road ends near construction work being done on the Calumet Skyway, which will eventually cut down on the stop-and-go driving we had from that point.

Eventually, Chicago: After handling some tight turns on Wacker Drive, Moore swung into the tunnel ramp leading to Greyhound's big underground loading concourse. Electric-eye signals held him briefly; then he got the dispatcher's light, rolled around to the dock it assigned him, and pulled in with a gentle sighing of air brakes. Time 10:55.

We had come 860 miles in 16 hours and 40 minutes actual running time, at an average speed of 50.7 m.p.h. We'd been set down in the heart of Chicago's Loop, in a swank modern terminal close to hotels, transportation, stores and theaters. Our luggage arrived with us (150 pounds rides free on a ticket). We'd saved money; round-trip fares between Chicago and New York, including tax, are about $40 by bus, $63 by rail coach, $73 by air coach.

There was one catch. As we said goodbyes to those going to California, Calgary, Oregon and other far-flung places, I had to duck the perfectly natural question they all asked in return.

How the heck could I tell them Bill and I were taking a bus right back to New York? END

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LEXINGTON, KENTUCKY

[Continued from page 117]

companies take the broad view that *any* studying an employee does on his own time is good for the company.

When does the company pay? Some refund the tuition immediately upon registration; others wait until the grades are in. Many of the latter will lend the tuition until time to settle up.

Who is eligible? Most programs cover both salaried and hourly workers. Some say any employee is eligible; others specify he must have a year or so of service. But that doesn't mean that everybody who wants in gets in. For college courses and many skilled-craftsmen courses, a high-school diploma is essential. And aptitude tests preselect the most promising candidates for very generous programs.

Besides the companies I've mentioned, here are 17 other blue-chip firms with tuition-aid plans: Eastman Kodak, American Cyanamid, B. F. Goodrich, Western Electric, Armstrong, American Cord and Webbing, American Viscose, Celanese Corp., Brown and Williamson Tobacco Corp., General Dynamics, American Gas and Electric, Food Fair Stores, Bigelow-Sanford, M. W. Kellogg, Standard-Vacuum Oil, Home Life Insurance, Metropolitan Life Insurance.

3 Alternate college and work periods

This is the "co-op" plan for earning a college degree in five years—a college student shares a full-time job with a classmate. They alternate on the job and in the classroom. The money earned in the work phase is usually more than enough to carry all expenses.

Last month in the article "You *Can* Afford to Send Your Child to College," PS mentioned several colleges cooperating in this program. Here our concern is with the cooperating companies, and there are more than 600! They include such firms as DuPont, General Dynamics, Armco Steel, Allis-Chalmers, Armstrong, Chrysler, and International Nickel. RCA reports it has 96 "co-op" students working at plants in Camden, N. J.; Cincinnati, Ohio; Harrison, N. J.; Lancaster, Pa.; Moorestown, N. J.; Somerville, N. J.; and Waltham, Mass.

Perhaps the most unusual cooperation scheme is that of General Motors, which operates its own "co-op" college, the General Motors Institute, at Flint, Mich. Students—about 2,500 of them—divide their time between instruction at the institute and carefully planned work assignments in GM factories or dealerships. They change from study to work and back to study every month or two.

Technically all student "appointees" must be sponsored by a division of GM. However, if your son is not now working for GM and is interested, he can apply by writing to the Registrar, General Motors Institute, Flint, Mich. A sponsorship will be arranged if he qualifies.

4 Go away to school at the company's expense

You will find that many companies now are setting up scholarship programs for employees (or their children).

The Food Fair Stores Foundation offers personnel of that supermarket chain 78 scholarships a year. They typically are renewed annually and have a value over the four college years of $1,000 to $4,000. Among other companies that reserve scholarships for employees (or employees' children): Standard Oil of New Jersey, American Steel & Wire, Chicago Tribune, General Electric, Goodall-Sanford, Hotel Statler, Monsanto Chemical, Norfolk & Western R.R., N. Y. Airbrake, U.S. Steel.

Owens-Illinois scholarships (more than a dozen) are open to others besides its employees, and it offers, in addition, to guarantee the winners summer jobs. Minimum pay: $600 per season.

The Johns-Manville Corp. has a unique program of aid which it calls "Company Offers" rather than scholarships. If it would like an employee to undertake a particular course of study to make him more valuable to the company, it will send him to college at full company expense—and at full pay.

Free education for your youngster needn't stop with college, either. Many firms have fellowship programs, for employees going after advanced degrees, which are far more generous than the companies' undergraduate scholarships.

Many an employee who starts off well at free education may find his employer paying him to keep going. END

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Toughest Rescue in Mining History

[Continued from page 127]

mines since he was 16. Tiedemann selected the team to work with him, choosing the strongest, ablest and most courageous of the miners.

Spiess and Effenberger, sitting in the darkness, knew nothing of the rescue work going on within a few hundred feet of them. Cold was no problem, the temperature of their area being close to 80 degrees Fahrenheit. But their limbs were beginning to stiffen. To keep them limber they took occasional exercise, stumbling up and down the dark pit. By now, they were beginning to get slightly faint from hunger. Water helped ease pangs from empty stomachs.

Spiess, a deeply religious man, prayed a good deal. Effenberger recalls: "I always had big ideas about being a success and about making money. Somehow, these things no longer seemed important. The important thing was to be alive."

They both worried a great deal about their wives and children. How would they get along if . . . Effenberger's wife and son were in the Russian zone of Germany, near Leipzig. Plans had been laid to get them out, and into free Germany by Christmas. What would happen to them if the Christmas reunion didn't take place?

Below them that fourth day at Level 8, the drill was biting into the rock. But its progress seemed torturously slow—seven feet an hour when everything went right. As a precautionary measure, Mieles decided to start a second boring. A borrowed drill was set up a short distance down the tunnel from the first.

By the fifth day, Spiess and Effenberger could hear the faint grinding sound of the approaching drill, guessed what it meant. From time to time it would stop while workmen below screwed on another length of shaft. There were moments of terror. Had the drill broken down? Was the rescue effort being abandoned? Trying desperately to signal, they pounded on mine rails with iron bars. Then the most wonderful of all sounds—the faint grinding—would begin again, all the time getting nearer.

At three a.m. of the sixth day there was a crunching sound on the floor of the dank prison. Effenberger switched on a light. There was the slowly rotating head of the drill. The two men grabbed bars and started pounding furiously. The crew of rescuers heard them. They had gotten through. Then began the long job of pulling the drill shaft out, uncoupling sections one at a time.

Banking on success of the drilling, Mieles had made advance preparations. He had ordered the mine machine shop to make a slender, four-foot-long aluminum "bomb." Packed with food, this would be pushed up through the hole to the trapped men. A company doctor had drawn up an appropriate menu for semi-starved men: porridge, zwieback, milk, dextrose, tea, chocolate. Other things were packed in the bomb: lamp batteries, pencils, paper, a ball of string—to be used to draw up a telephone wire. A miner's lamp was fastened atop the bomb, its beam pointing upward, so the trapped men could see its approach.

For hours Effenberger and Spiess hovered around the top of the drill hole. Then, peering down, they could see the faint light approaching. "Here comes salvation," said Effenberger.

By December 3, Tiedemann and his crew had the old shaft retimbered so it was safe. They were now ready to begin work on the rescue shaft. Starting above the cave-in area, and proceeding in a slanting direction so as to avoid as much of the loose, shifting rubble as possible, it had to traverse a distance of 40 feet. To prevent further cave-in, the new shaft was boxed with heavy timbering as it progressed downward.

Since the shaft was small—46 by 50 inches—there was usually room for only one man at a time at the advancing face. Big stones were broken up with drills, Fragments were loaded in iron buckets, and the buckets passed upward to men clinging precariously to timbering. As many as 14 men at a time crowded into the small hole. At moments of greatest pressure, the exertion required of the man at the face was such that even the strongest could last no more than 20 minutes. Relief took over while he had a rest period.

Spiess and Effenberger had eaten the food from the first bomb with the full expectancy that from now on there would be a steady supply. Then Bomb No. 2

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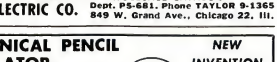

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jammed in the shaft, probably against loose rock. It had to be drilled out—a 24-hour job. Hunger and despair returned to the trapped miners.

With communications re-established and food transport up and down the drill hole working smoothly, life became more tolerable. Soap was sent up for baths in the iron tubs. Letters to wives came down—also a message: "How about a steak?"

Working under conditions almost fantastically difficult, Tiedemann inched his shaft toward the trap area. On the eighth day it broke into the entry. "You are all right now," called Tiedemann. Word was flashed to the surface. Ruth Spiess bought a bunch of flowers for her husband. Rescue seemed minutes away. Then the earth gave another convulsive shake.

There was another deep rumble. The rescue shaft was well timbered and had survived. But the previously open space at the bottom of the shaft was now closed by tons of loose rock. The trap had been sprung again.

On a round-the-clock basis, the new cave-in was attacked. On December 8 at five p.m. the final break-through was made. Rescue was at hand—the longest, most difficult rescue in modern mining history, and probably, at $30,000, the most costly.

Tiedemann, rightly idolized by the men who work for him, crawled through the opening. Not knowing what emotional state the trapped men might be in, and not wanting anything to go wrong at this moment, he sat down and started chatting matter-of-factly.

He told how the rescue had been effected. It had been quite a job. The biggest job he'd ever undertaken. Yes, the letter Effenberger had written his wife had been mailed. He could start for their reunion in a couple of days, after a routine hospital check-up.

As he talked, Tiedemann watched the two men—whose faces were covered with stubbly beards. Finally, he was convinced that they were strong enough to clamber up the timbering in the rescue shaft, and climb in the big steel bucket for the ride up to Level 7.

Casually he rose, stretched. "Come on boys," he said. "Time to go. This shift has lasted long enough." END

Amateur 'Moon Watchers' Get Set

[Continued from page 137]

field of his telescope. "Out," "In," and "Out of the field," he may call as he does so. (At stations that dispense with signal buttons, and use the observer's voice directly for timing, short prearranged words like "Time!" or "Mark!" would have to be used.)

All this may happen fast—in less time than it takes to tell it. At its nearest 200-mile approach to observers, the satellite will be going as fast as 1.3 degrees a second, and so will be visible for less than 10 seconds in a watcher's 'scope.

At a satellite finder's jubilant shout, do his fellow-observers drop their tasks and join in a look? Nothing of the sort! With spartan discipline, they must keep right on with their own watching, resisting any temptation to desert their posts. It's possible that the supposed sighting was a false one, perhaps mistaking a plane's lights for the satellite—and the real one might come past another watcher a moment later.

The one who does share a look at the satellite is the team's leader, for it's his duty to make sure there's no mistake about it. He'll follow it with a telescope or binocular of his own. So that he can swing his instrument into the satellite's path in a hurry, it may need a quick-adjusting mounting of special design; that's the problem they've been working on most recently at Silver Spring.

The scene of action shifts, once a satellite sighting's verified. The team goes indoors, for a playback of the tape recording. Starting from an identified even minute, the leader and several observers count the seconds of the time signals, up to each "beep" of the electric button. When all agree on the count, the leader jots down each time, upon a rough pencil sketch of the satellite's path across the observer's field of view.

Since each watcher's view of the sky is limited to about 12 degrees, the declination or altitude of the satellite's meridian crossing is roughly fixed simply by which observer saw it. This observer should be able to refine the figure's accuracy to within one degree, by estimating how high or low in his field the satellite crossed the mast.

Notes in hand, Wright as team leader will then pick up his telephone and

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call Moonwatch headquarters, the Visual Tracking Center set up by the Smithsonian Astrophysical Observatory at Cambridge, Mass. Having identified himself and his station, he'll read off the data of the satellite sighting.

An electronic brain takes over now. At the Center, Wright's figures will promptly be fed into a huge computing machine, together with the latitude and longitude of his Silver Spring station. These last figures are already on file at the Center for all registered Moonwatch stations, which are the only sources from which amateurs' reports of sightings will be accepted for use.

From leaders of other Moonwatch stations, similar telephoned reports will be coming in at the Center, and will likewise be fed into the electronic brain. Chewing on the first scattered few received, the computer will tentatively calculate the satellite's orbit and predict its future path. As it digests later reports, it will revise its calculations, and foretell the course of the "moon" more and more accurately.

The amateurs will have professional rivals. Scientists are setting up a worldwide net of radio receiving stations to track a satellite, by the signals its Minitrack radio transmitter will continuously emit during the batteries' life of about three weeks. The Minitrack observing net will chart the "moon's" orbit with an electronic computer of its own.

Lastly, giant Schmidt cameras will have been set up at strategic points over the globe to track the satellite with the greatest precision of all. Their photos will be essential to the important scientific studies that depend upon observing the satellite's motion. But these ultrapowerful telescopic cameras have so limited a field of view, only three degrees wide, that they'll be unable to find the satellite themselves. They'll have to be directed to it, by either the Moonwatch or the Minitrack network. So will astronomical observatories' great telescopes.

Now, if all goes according to plan, the scientists' Minitrack network will be able to locate a newly launched satellite promptly—and to tell the Schmidt stations where to point their big cameras.

Where do the amateurs come in, then? Initially their role will be to backstop the scientists. Suppose a satellite's radio doesn't work—unlikely, but possible enough to give the Minitrackers bad dreams. Then the tiny globe could be lost in the sky and never found again. Not only would that particular launching go for naught; if it happened to be the only successful one of the whole series, all the effort and expense of the $50,000,000 satellite project would have been in vain. Unless, that is, devoted amateurs at toy-sized telescopes could locate the silent satellite and save the day. If a "moon" is lost, the amateurs' Moonwatch stations will go on an emergency schedule of continuous evening and morning watches until it's found.

The leading role will go to the amateurs, in any case, before the end of a satellite's career. Eventually its orbit will wobble unpredictably, as it loses altitude and spirals downward into the earth's atmosphere. Then the Schmidt cameras will lose it. Its radio will long since have gone dead. Only the amateurs will be able to keep on following the "moon" during the last and especially interesting period of its existence. That is the time when its motion, by revealing the unknown density of the rarefied air up there, will tell what scientists and future spacemen need to know about the very fringe of the atmosphere.

In between, during the major part of a satellite's life—which may range up to a year or more, if it can be placed accurately enough in its intended orbit—Moonwatch teams will keep in practice observing it. Taking many factors including weather into account, observers at a typical Moonwatch station should be able to see the satellite something like once a week on the average (though actually at more uneven intervals), either during evening or early-morning twilight hours. For as long as a satellite follows a known and predictable path, those will be the times when the Moonwatch teams will assemble and go into action.

History will be made by amateurs of Moonwatch. Says Dr. J. Allen Hynek, in charge of the optical Satellite Tracking Program: "We believe that these teams may well be recognized in the future as pioneers in the greatest scientific research project ever participated in by non-professional observers." END

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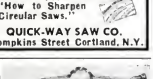

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[Continued from page 141]

refineries are blown up in war, it can run on crude oil; we have fed it everything from 100-octane gasoline to shale oil."

GM's next move, says Underwood, is to put a free-piston locomotive on the rails. The engine will be a "siamesed unit"—two gasifiers will pipe gas to a common turbine geared to the drive wheels, delivering 1,500 to 2,000 hp. This locomotive, which will be running by the end of the year, is not the first of the new motors to drive an iron horse. Since 1952 a free-piston locomotive built by Renault, the French auto maker, has piled up more than 60,000 miles hauling a 240-ton train daily between Paris and Cambrai. A single gasifier drives the turbine, delivering about 1,000 hp. to the wheels through reduction gears. Operation has been simple and trouble-free. Efficiency reportedly matches that of the diesel, burning the cheapest residual fuel oil. "No other locomotive," states *The Engineer's Digest,* "approaches the successful compromise between first cost, maintenance and fuel cost, as demonstrated by the French experiment."

While several inventors were early workers on the free-piston principle, chief credit is given to Marquis Pateras Pescara of Spain, a helicopter pioneer who built an engine in 1923, thinking it might drive an ungainly whirlybird he had made. It didn't. But the novel engine attracted wide attention. Junkers of Germany built free-piston air compressors without the turbines. These were used on German U-boats during World War II. Marquis Pescara sold his patents 20 years ago to a Swiss engineering group. Its two associated French firms, SIGMA and SEME, are now leading manufacturers. Last year about 80 free-piston engines were in operation in Europe for marine and stationary power. Associated British Engineering Ltd. has contracted to build the world's largest free-piston plant, of 36,000-kw. capacity, as a part of the Singapore public-utility system.

Like the diesel, the free piston has first proved itself in big installations of the "draft-horse" class. While it took diesel breeders about 35 years to produce a "mule" (trucks, tractors, buses), there is every indication that the new engine will reach this status much earlier. Already committed to commercial production for ships and locomotives, General Motors will next develop heavy-duty automotive engines. International Harvester's research department is also working on an engine, and regards it as attractive from the standpoints of performance, economy, simplicity and operator-comfort.

Ford is setting no sales date for its tractor, but Dearborn top brass recently asked its free-piston engineers what they would say if given unlimited funds and orders for full steam ahead. They replied that they would rather work on the engine for a while.

"We have two goals for further development," said Klotsch. "We should be able to run the pistons at twice their present speed and double the power output. Of course that involves a lot of engineering. And we should develop automatic controls for the bounce pressure [the compressed-air 'springs' that force the pistons back together when they reach the end of their outward strokes] and for the maximum effective working stroke of the pistons. Today the pistons do about what they want to do; we want them to follow definite orders. They will become less 'free' but more efficient."

There is little doubt that under a crash program a line of free-piston-powered heavy-duty vehicles *could* appear in the salesrooms in three years. But engineering is only one factor in such a decision, and the date of debut is still cloudy.

The free-piston passenger car—the "race horse" of the line—will come last on anyone's schedule. Dr. Donald H. Frey, associate director of the Ford Scientific Laboratory, believes that any new motor that supplants today's gasoline engine must weigh less, occupy less space, cost less, operate more economically and give better vehicle performance, and that not a single one of these factors can be ignored.

That is a tall order, but men like Paul Klotsch are confident that it can be filled. They know they are shooting at moving targets, for far more money and talent are being spent on improving the straight gas turbine and the gasoline engine. If such men prevail, we may have a superior, cheaper car engine that will convert fuel oil into mileage now unheard of. END

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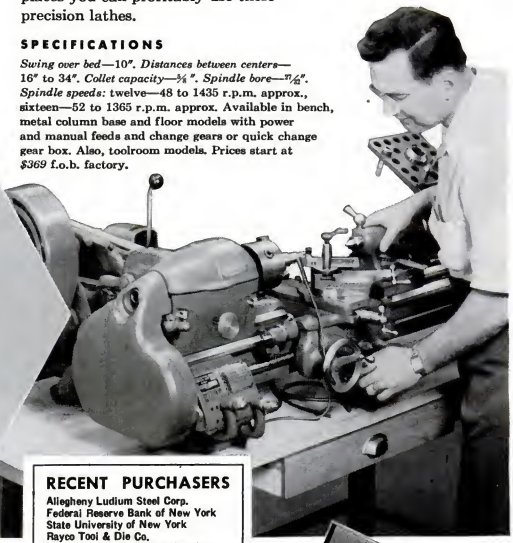

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